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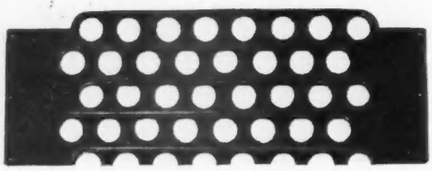

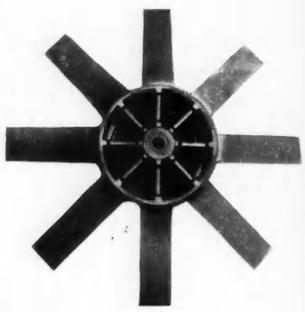

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Both creep tests and multi-rupture tests are made in this machine at the Electrical Research Association's Leatherhead laboratory. In the multi-rupture test, three specimens are loaded in series until one fractures, and the time to fracture under varying load-temperature conditions measured. The assistant is shown tying thermocouples to a specimen.

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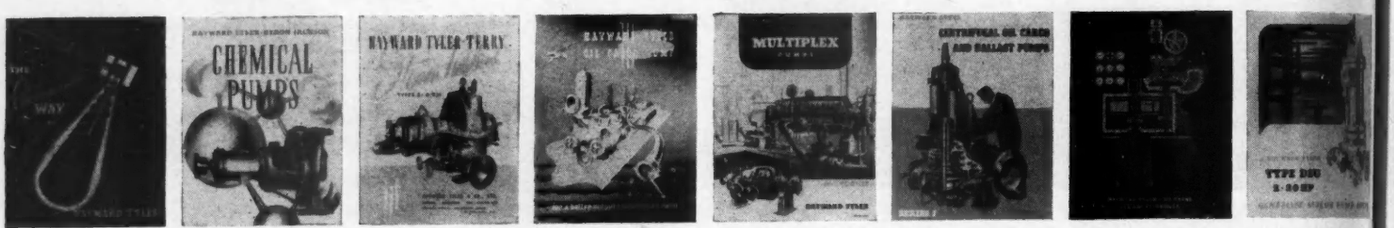

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ENGINEERING Impact

of the Crumbling Barriers of Science

"OF ALL the research workers since the beginning of time, 90 per cent of them are alive and working today," says Professor Pierre Auger in his recently published book, *Current Trends in Science Research* (HM Stationery Office, £1 3*s*).

The author of this revealing 250 page book goes on to point out that scientific activity is increasing at the rate of 10 per cent per year; in other words, it more than doubles every decade.

The trend toward scientific specialization is apparently being accompanied by a parallel movement toward unity in science. The old barriers are falling with the growth of new sciences and, at the same time, the role of mathematics has broadened to the point where it pervades all sciences, substituting precision and prediction for trial-and-error.

Another barrier is also crumbling—that between applied and fundamental science. While Professor Auger notes that applied research has grown to the point where there is a danger at times that it might squeeze out disinterested research—which would be as absurd as killing the goose that lays the golden egg—there is now a fortunate tendency toward a blending of the two.

The author detects and analyses twelve main trends in world scientific research, and finally singles out the interaction between the various sciences themselves for full examination, with mathematics in a royal role. "Almost as if they could foresee the needs that would gradually come to be felt by physicists, chemists and biologists," he remarks, "the mathmaticians have almost always evolved in advance the purely logical theories containing the required tools of thought."

In the eyes of Professor Auger, these present trends in science are not creating a "science-fiction" world dwarfing man into insignificance. On the contrary, he stresses that human biology is to be found at all levels of pure and applied research today. Automation has not replaced the observer and the demands of the human mind are the very source of fundamental discoveries in science.

Economic Planning à la Française

AT a time when even the Chancellor of the Exchequer seems to be talking about the necessity for a national economic plan so that industry can really practice economic forecasting (instead of staggering from one budget to another, with the intermediate complications of "little budgets") PEP have published a pamphlet, "Economic Planning in France" (Political and Economic Planning, 16 Queen Anne's Gate, London SW1, 5*s*).

It describes how the Commissaire Général du Plan has steered France successfully through three four-year plans and half way through a fourth. The pamphlet is an account of a conference held jointly by the National Institute of Economic and Social Research and the Institut de Science Economique Appliquée.

Since France has achieved an economic growth twice as fast as Britain's during the period of these four-year plans, and since most of the conference delegates attributed a large part of this growth to the plans, it is hoped that the pamphlet will suggest some constructive ideas to the Treasury. Broadly speaking, the French type of national plan is not the product of a government directive but of a voluntary feedback into a central coordinating body of the plans of different sectors of the economy.

Run by a small permanent staff and much voluntary help, the Commissaire Général works through a number of "commissions" to ensure cooperation between the administration, industry, the trade unions, academic experts and consumers. There are now twenty such commissions dealing with different industries or branches of social activity. When the different points of view within each commission have been reconciled, and when a common policy has been agreed, the commission then feeds back its recommendations to the Commissaire Général. This central body then pieces together the reports of the different commissions to coordinate economic activity in the four-year plans.

Effective Coordination

This type of economic planning is much more effective than the limited work of the two bodies which have so far been concerned with what overall economic planning there has been in the United Kingdom. One hopes the Treasury took note when Sir Robert Shone, of the Iron and Steel Board, said in his impressions of the conference, "The French experience in bringing these plans . . . together, and determining national policy on the basis of a four-year investment plan, throws up possibilities for this country."

One hopes, too, that Professor de Wolff, of the Netherlands Central Planbureau, was right when he concluded the conference by saying, "The slow pace of economic development in Britain might also prove to be the kind of challenge which leads to a greater interest in economic planning."

Speed Limits on Goods Vehicles

THAT it is realistic to contemplate an upward revision of the speed restrictions now imposed on commercial vehicles has been positively demonstrated by an investigation conducted by the Traders' Road Transport Association, the national body for firms operating vehicles under a C licence. The same inquiry showed that the time is not ripe for the total abolition of the restrictions.

The study was made as a preliminary to forming an association policy now that the Minister of Transport has said that he is to look into the problem. At the moment, goods vehicles are kept—according to the law—to 30 mph whether in a built-up area or not, except on the motorways where the driver is freed from speed limits. Well maintained commercial vehicles possess efficient braking and steering and the drivers are professionals; and, as most light vans are built on a car chassis, there seems little reason why they should not be treated as motor cars.

With the continual introduction of no parking, no right hand turns, one way streets, and now clearways, much is being done to quicken traffic. Average speeds are nowhere near 30 mph in areas where these arrangements are coming into force, but the restricted driver must contribute to congestion and certainly irritates others. For the moment, the existing speed limit is no more than an imposition on the traffic planning department of a firm, giving rise to unnecessarily high costs.

of Steel Firms Growing

THE iron and steel industry of Britain is determined to expand in the long term, no matter what immediate economic measures are taken by the Chancellor. This is apparent from a booklet, *Steel in the 1960's*, prepared by the British Iron and Steel Federation. It amounts to a virtual vote of confidence in the expansion of British engineering, for the iron and steel industry's plans are a sensitive barometer of how the engineering industries themselves hope to expand.

"The British steel industry is engaged upon a programme of unprecedented technical innovation and expansion," the Federation say. "Already, in the fifteen years since the end of the War, production has roughly doubled (24·3 million ingot tons in 1960) and productive capacity by the mid-1960's will be about 34 million tons of steel." This figure compares with the upper demand estimate of 32 million tons.

Voices of concern about the Chancellor's "Little Budget" are heard; for instance, Lord Ridley, chairman of Consett Iron Company says: "The reduction in demand which will be caused both by the higher indirect taxation and by shortage of credit may in the short term reduce inflationary pressure, but it will also increase costs and is unaccompanied by any long-term proposals to enable industry to reduce costs and to make the substantial increase in our export trade which is necessary."

The steel companies' expansions include large-scale use of oxygen steelmaking. Productive capacity in 1965 should be some 4 million tons from the LD oxygen-blown steel converters and their modifications, according to the Federation's report. The Kaldo process, which is a somewhat slower oxygen process and is said thereby to provide closer control, is being introduced into three steelworks. Lord Ridley himself leads a company whose works will be the only one in the world to use both the LD and Kaldo processes.

Telling the World What Britain Makes

ONE of the most active of organizations furthering the publicity side of export promotion in the United Kingdom is the Central Office of Information. Each day a service of industrial news, amounting to 2,500 words, is sent out to the European press and this is supplemented with special programmes of news, photographs and pictures.

Functioning as the Government's common service agency for information work, the COI carries on publicity for export promotion for the Board of Trade and, in Europe, for the Foreign Office. That the COI works to some effect in seeing that United Kingdom firms are mentioned in the world's newspapers is demonstrated by the way in which more than 2,000 British firms and trade associations have received cuttings in the past nine months from the overseas papers as the result of COI activities.

Engineers and executives familiar with overseas British trade fairs, in fact, will often have been looking at stands and settings for which the COI has drawn on its exhibition experience. Documentary films, including those for television services, radio-tapes, booklets and magazines, are all used by the COI in putting the stories across.

All this outpouring of information needs plenty of source material. It is up to firms to take advantage of the COI's facilities by reporting what they are doing.

Leaders of the COI recently received representatives of the Export Council for Europe, including Sir William McFadzean, President of the Federation of British Industries, and other chairmen and managing directors, and explained something of the workings of the department.

and Streamlining Port Operations

NO TWO ports are the same, but the London Chamber of Commerce has produced a yardstick for all the country's ports in the report it has just published on the difficulties users experience in the London docks. The report puts forward suggestions for the comprehensive development of the docks, with the possibility of government help to implement the scheme, and points out the need for an overall assessment of national priorities of expenditure so that transport facilities in and out of the country shall keep in step with those within.

The report will be submitted as evidence to the Rochdale Committee which, on behalf of the Government, is considering to what extent the major docks and harbours of Great Britain are adequate to meet present and future needs.

The more widespread use of shift working is recommended for consideration as a counter to the faster working that is effected through some continental ports. Steady working without interruption is the most important factor of all in avoiding delays and ensuring expeditious handling says the Chamber. From this it follows—and the Chamber themselves make the point—that there has got to be more intelligent operation on the part of the users; refusal to accept deliveries from the port over the weekend—or even on Fridays—cannot be tolerated. More staff for the Customs and more mechanization would then see freight handled quicker.

What goes for London largely applies also to other ports. To save duplication it may well be that, within limits, the fewer the ports the easier improvements would be put into effect. The country has at least 25 ports offering ocean facilities of sorts. Shipping units are getting larger so that more and more equipment, longer quays and deeper channels are all required. London is to make a start with its £20 million development at Tilbury, but who is to decide which other ports should receive like treatment?

Helically Welded Special Purpose Tube

Helically formed and welded tubes (or pipes) can now be made in many materials by Bristol Aerojet using specially designed equipment and accurately controlled welding processes.

ANY company whose forbears had their roots in the aircraft industry will have inherent regard for high-quality work and lightweight structures.

Bristol Aerojet, jointly owned by the Bristol Aeroplane Company Limited and the Aerojet General Corporation of America, had their origin in 1958. They were set up to develop and make rocket motors utilizing solid propellants.

To engineers brought up in the traditions of, say, the automobile industry or even the aircraft industry, rocket motor manufacture may appear superficially to be relatively simple, but in fact the manufacturing technology of a solid fuel motor case is of a very high order.

Bristol Aerojet's present work is largely concerned with the design, development and manufacture of rocket motor cases and pressure vessels from high tensile steel. The pressure vessels are of the type designed for a system where a reservoir of gaseous energy is required or where it is necessary to store gas supplies at high pressure. For instance the storage of oxygen on aircraft or for use in conjunction with fire extinguisher equipment.

The processes, techniques and equipment developed for this class of work are highly specialised. A great many components are manufactured from a 1 per cent chrome molybdenum steel, broadly similar in composition to SAE 4130, but with improved weldability and mechanical strength brought about by reductions in the permissible level of deleterious impurities. The improved specification is of benefit in producing defect free welds and more consistent strength after heat treatment. Taking into consideration the nature of the materials used by Bristol Aerojet, crack-free welding is essential as the thickness of the materials used is often such that a crack of, say, 0·010 in in length could traverse more than half the section thickness. Apart from this obvious consideration, the propagation of cracks under stresses induced by external loads or of residual origin, would be expected to be catastrophic.

A rocket motor case is basically a lightweight pressure vessel containing a propellant charge which, during burning, generates high pressure gas at a high temperature. Because of the critical relationship between weight and performance, the rocket motor casing must be as light as possible consistent with adequate strength.

Large rocket motor casings are usually made from sheet steel, mainly because solid drawn tube of the relatively large diameter required is not readily available, another reason being that it is difficult to ensure the precise uniformity of wall thickness which is required.

Many cases are made at the present time from low alloy steel sheet capable of heat treatment to give tensile strengths up to about 80 tons per sq. in. The thicknesses range from 0·025 in to 0·10 in. At present most of the cases are produced from rolled sheet, longitudinally and circumferentially welded to make suitable diameters and lengths. Hydraulic stretch forming is frequently employed to obtain the high degree of dimensional accuracy which is required.

In the course of developing and manufacturing rocket motor cases, Bristol Aerojet have gained considerable practical experience in the accurate manipulation and high-quality welding of high tensile steel in thin sections. The quality of the welding is such that the presence of welded joints can usually be overlooked in design calculations. In testing rocket cases to destruction, they usually fail outside the weld region rather than at the weld itself.

Perhaps the most interesting development the company are undertaking is the introduction of helically welded motor cases. The conventional method of manufacture using longitudinal and circumferential welds presents practical difficulties in producing a perfectly round tube. As previously mentioned, it is not practicable to obtain solid-drawn thin-walled tube for the large diameters required and because thinness and lightness are two of the essentials for the cases, it would obviously be very expensive in time and material to use heavy gauge tube and machine it down to the required dimensions.

Helically welded tube is produced from strip which is helically wound on to a mandrel and simultaneously butt welded to form a tube. This technique allows tubes of large diameter and length to be produced in any weldable materials. At present Bristol Aerojet manufacture helically welded tubes from 3 in to 54 in diameter and from 0·015 to 0·20 in wall thickness. Tubes smaller in diameter than 3 in can be produced commercially using one of several manufacturing techniques, but for larger diameter tubes with relatively thin walls and materials which are normally difficult to work, the helical welding process has proved to be advantageous.

The method is quicker, more flexible and needs less equipment than for the wrap-and-weld method. Bristol Aerojet have developed their own machines for the process and high welding speeds are possible.

As the technique develops it is considered that helically welded tube will supersede wrap-and-welded tube for the construction of rocket motor cases. The use of steels with tensile strengths above 100 tons per sq. in is facilitated by helical welding because of the elimination of the longitudinal joint which is often a source of weakness at very high strength levels. At the present time tubes are being produced in high tensile steels of various compositions, in aluminium, monel, nimonic alloys and stainless steel.

(Left) Helical welding of strip to make 10 in dia tube. (Right) An example of helically welded tube. This piece is 18 ft long and 10 in dia by 16g. Tube such as this has been made in HT steel, aluminium and stainless steel.

Possible Applications

Applications for helically welded tubes in the more commercial world outside rocket manufacture suggest themselves for consideration. Containment and transmission pipes in the chemical and processing industries and in the nuclear field using special materials are obvious applications. Jet pipes and after-burners for aircraft engines together with aircraft ducting are another possibility. Printing rolls at present made from cylindrical components machined on the exterior surface could be reduced in cost and weight if fabricated from helically welded strip. The availability of strip in a wide range of materials compared to the comparative scarcity of wide sheet, indicates that from the point of view of raw material supplies the helical process offers considerable advantages.

The economic advantages of the processes are considerable provided that an adequate welding standard can be maintained. Because of the influence of material composition on weld quality, Bristol Aerojet are actively engaged in cooperation with the material manufacturers in the development and production of improved alloys of many types which can be employed to the maximum advantage utilizing the helical welding technique.

Bristol Aerojet Limited, Banwell, Somerset.

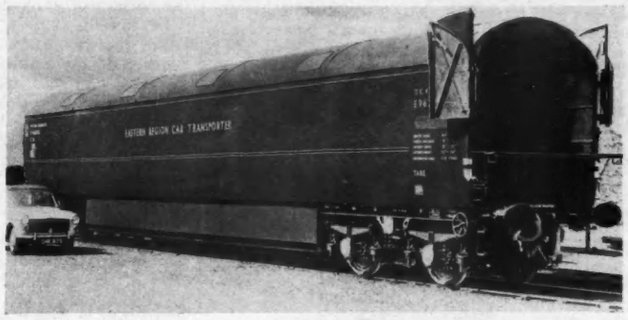
90 mph Double-Deck Car Transporters

The first of 14 double-deck car transporters ordered by the Eastern Region of British Railways will shortly go into service between Kings Cross and Perth. Each transporter can carry seven small cars on the two tiers, or a lesser number of larger ones.

The vehicle covering is wholly constructed of glass reinforced plastic formed in panels which are bolted together. The design of the covered transporters, which are built by Newton Chambers, is generally on the lines of the earlier open vehicles but there have been modifications in detail to allow them to operate successfully and safely at passenger train speeds of up to 90 mph.

With this in view, they are fitted with the automatic vacuum brake as used on all railway carriages and with the Westinghouse compressed air brake standardized on the Continent.

Perhaps the most important feature of the transporters lies in the provision of two power-operated lifts each accommodating one motor car. In loading, the lifts are raised so that the bottom floor of each lift is level with the common top floor of the vehicle. The cars are driven up a ramp on to the top platform and are placed in position on the hoist. This hoist is then lowered, leaving the cars on the bottom deck, while the top deck is then flush and ready to receive additional cars.

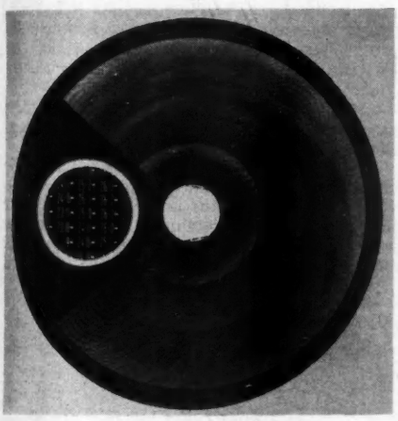


These double-deck car transporters can be hauled in trains at up to 90 mph. Vacuum brakes and compressed air brakes are fitted, making them suitable for use in this country or on the Continent. The vehicle covering is wholly constructed from reinforced plastic panels.

Newton Chambers and Company Limited, Thorncliffe, Sheffield.

Optical Weighing Scale Gives 104,940 Computations

Earlier this year, Avery's introduced their "Aristocrat" weighing scale. The physical limitations of the price computing bands on the conventional type of scale created the need for a machine which could cope with the rising prices and the widening variety of goods sold.



A section of the glass graticule of 8 in diameter magnified to show some of the 400,000 characters.

Size has been the major barrier to the design of computing charts keeping pace with changing prices both on the fan and cylindrical types. The Aristocrat has a weighing capacity of 20 lb and is sensitive to within 1 dram. It has a price range of 1*s* 6*d* to 12*s* per lb at 109 different prices per lb.

The number of computations is 104,940. This is made possible by using the rotating dial principle but employing a circular graticule of 8 in diameter, on which is contained all the weight and price information. A projected image of the appropriate part of the graticule is displayed on viewing screens. Production of the master graticule—comprising some 400,000 characters—necessitated the development of a special purpose machine to index the master to the correct position and to expose appropriate price numerals.

The size of each of these characters is 0·010 in tall and 0·002 in wide, and these are projected and magnified 14 times for the weight display and 24 times for the price display. To bring home what this really means, 25,000 of these characters could be contained within the area covered by a sixpence.

In view of the small size of the characters on the graticule, the optical projection system for the price information posed special problems. It is necessary to move the projection system across the graticule and locate it accurately to project from the appropriate price ring. This movement must be under the user's control. A carriage moving on accurately machined guides, carries the essential optical components, the guides being provided with adjustments to ensure that the optical system positions itself correctly with respect to the graticule for each of the 109 price settings.

The simultaneous display of price and weight is done by splitting the projected light beam after it has passed through the graticule by means of a dichroic mirror. This mirror both transmits and reflects the light with a very low absorbtion in the mirror itself, thus making maximum use of the available light. The two resulting light beams are led by separate mirror systems to the retailer's and shopper's side of the scale. Once the system is correctly set it must display the same information on both sides.

W. and T. Avery Limited, Soho Foundry, Birmingham 40.

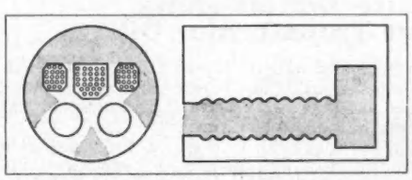
Three-Pass Wet Back Shell Boiler

An entirely new design of three-pass wet back boiler known as the "Maxecon" has been developed by Richardsons Westgarth. The basic feature of the design—the submerged combustion chamber—follows practice with which the firm have had long experience.

While maintaining maximum reliability, the design has been streamlined by modern welding techniques. The special shape of the combustion chambers enables cross stays to be eliminated and a third pass section inserted. This is said to give high efficiency without the use of an economiser.

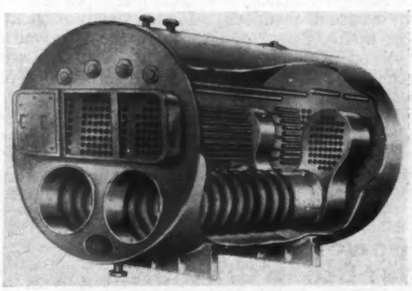
Easy access for internal examination is afforded. The whole surface in contact with water or steam can be examined from inside the boiler, a feature not available in many shell boilers.

The top row of tubes in the third pass is arranged in line with the tops of the combustion chambers, thus making the most efficient use of the space available in the boiler shell below the water line. This provides adequate water coverage to protect the heating surfaces while still retaining a large steam space and height above water level to ensure good steam purity. The water volume is also large which in conjunction with the arrangement of the heating surfaces to give good circulation ensures that rapid response to fluctuations in load is obtained without sudden changes in water level.



In the Maxecon boiler, a man can enter all the shaded areas shown above.

Elimination of combustion chamber brickwork not only cuts out a potential source of high maintenance costs, but reduces the heat loss due to radiation; and construction of the flue connection to the chimney stack is simplified.



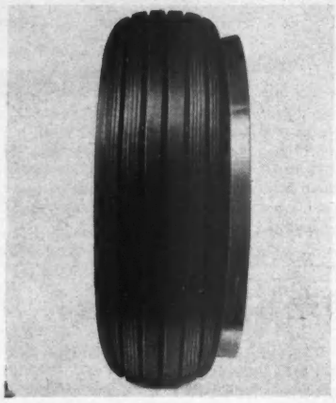
The boiler is suitable for oil, gas or solid fuel firing, and works at up to 250 lb per sq. in. The Double furnace gives 11,000 to 23,000 lb of steam per hour, the Special 23,000 lb per hour upwards and the Single furnace—which is under development—4,000 to 10,000 lb per hour.

Richardsons Westgarth (Hartlepool) Limited, PO Box 19, Hartlepool, Co. Durham.

Stopping Spray Entering Jet Engines

A problem of take-off encountered by certain types of jet aircraft is that in wet conditions the aircraft's nosewheel throws up a "bow wave" of water, the spray from which is liable to enter the engine air intakes.

The Dunlop aero-tyre design teams have developed a nosewheel tyre to combat this trouble. A triangular-section rubber chine formed integrally with the tyre wall is located on the outer wall of each of the twin-nosewheel



On wet runways, the chine on the tyre deflects the water away from the air intakes of jet aircraft.

tyres. This chine deflects the water downwards and away from the air intakes.

The company say that after extensive trials with various forms of chine a considerable degree of success has been achieved. Work continues on Comet and Caravelle aircraft.

Dunlop Rubber Company Limited, Aviation Division, Holbrook Lane, Foleshill, Coventry.

Another 2,000 MW Power Station

Work on the first of two large power stations which the CEGB want to build in Yorkshire is expected to commence in October. The new station will be situated on the River Aire at Ferrybridge on land which forms an extension to the site of the existing Ferrybridge A and B power stations.

The new C station with its installed capacity of 2,000 MW will share with the one at West Burton the distinction of being the most powerful steam station in Western Europe. The main plant will comprise four turbo-generators each of 500 MW capacity and four boilers each with an evaporative capacity of 3,450,000 lb of steam per hour. Steam conditions at the stop valve will be 2,300 lb per sq. in at 1,050° F, with reheat to 1,050° F. The total number of 500 MW sets on order by the CEGB is eight.

The first set at the C station will be commissioned in 1965 with the total completion of the station due in 1967. This station will provide the Yorkshire coalfields with an assured market of 5 million tons of coal per annum.

Power Cables for Steep Gradients

To withstand stresses arising from installation on a steep gradient, two special cables have been installed by British Insulated Callender's Construction Company Limited, as part of the Cwm Rheidol hydro-electric scheme near Aberystwyth.

Two mass-impregnated non-draining power cables of 4½ in diameter 3-core 33 kV were made by the Power Cables Division of BICC in single lengths of 1,800 ft, each weighing over 20 tons. In addition, two steel-wire armoured pvc pilot cables have also been supplied.

The power and pilot cables are secured in shaft type cleats bolted to a concrete slab formed in the bottom of a trench. They are installed on a 1,380 ft long slope at an average angle of 32° from the horizontal. Before the ground is reinstated, the cables will be protected with inverted concrete troughs for which anchor recesses have been provided in the concrete slab. Provision will also be made for natural ventilation. The cores of the 0·5 sq. in conductors in each cable are individually sheathed with lead to provide additional strength and for convenience of terminating in sealing ends at each end of the route.

Installation of the cables caused several problems because of their weight and the steepness of the slope. The cable drums could not be taken closer to the top of the hill than 250 yards, from which position the cable had to be drawn across a boggy field and lowered down the slope by two winches running simultaneously

Special cables installed to withstand stresses arising from the steep gradient.

wire bonds being attached at a succession of points. A hand winch at the bottom of the slope was used to guide the cable end to the transformer enclosures. The main winch used for lowering was equipped with a torque converter which enabled the heavy cable to be inched into the correct position for anchorage in teak cleats.

On completion of the power station the cables will carry the total outout from step-up transformers to connect with a 33 kV overhead line at the top of the hill. Consulting engineers for the transmission installations associated with the scheme are Kennedy and Donkin.

British Insulated Callender's Cables Limited, 21 Bloomsbury Street, London WC1.

Site Conditioning of Transformer Oil

For conditioning transformer oil on site, a self-propelled articulated vehicle containing a modified and improved version of the Ilovac unit has been introduced by Castrol.

The equipment is designed for filling new transformers with de-aerated "superdry" oil, and for conditioning the oil in a transformer when routine checks show that the amount of water present is excessive and has contaminated the windings. A mobile laboratory accompanies the Ilovac and all operations are monitored by careful checks on samples of the oil being treated.

The principal items of equipment are pumps, oil heaters, a centrifuge and a vacuum tank. Free water and soiled contaminants in the oil are removed in the centrifuge, and oil emerging as a fine mist is subjected to high vacuum for removal of dissolved water and air. The oil is also recirculated through spray nozzles in a vacuum tank to ensure that all oil is thoroughly processed.

The procedure for filling new transformers on site is that new oil from a tanker is processed in the Ilovac before being pumped into the transformer tank which should be maintained at a mild vacuum during the filling process.

For drying out transformers, if resistance checks or other tests show that transformer windings have absorbed undue quantities of moisture, much the same procedure is followed as for filling new transformers. The oil is, however, circulated at a higher temperature and the drying process may be greatly accelerated by raising the temperature of the transformer windings relative to the oil by applying a suitable voltage. In this way water is driven from the solid insulation into the oil, whence it is removed by the Ilovac.

Requests for the Ilovac service should be made to the address below.

Electrical Division, Castrol Industrial Limited, Castrol House, Marylebone Road, London NW1.

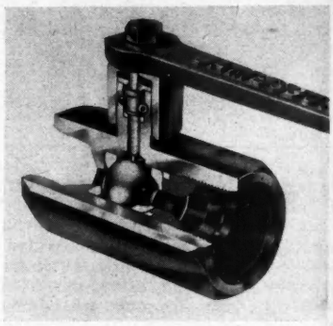
Double Seal Ball Valves

In the theory of valve design, the ball valve has always been considered one of the most efficient because it provides an unrestricted throughway, ease of operation and minimum weight. Absence of suitable materials to make tight long-lasting seals has, however, delayed acceptance of this design but such materials are now to hand.

A new company has been formed known as Jamesbury-Serck which originates from the Jamesbury Corporation of America and Serck Limited of Birmingham to make and market the Jamesbury "Double Seal" ball valve.

In this design the rotating member is a sphere located between two, patented, non-metallic seats. These seats are made in a variety of materials such as ptfe, Buna-N, Neoprene and nylon. The basic conception is the employment of a seal with a flexible lip which is deflected on assembly to create an initial sealing force independent of line pressure.

The dimensions of the lip are such that as the ball is rotated the lip follows the contour of the radiused port-way, thus ensuring full support throughout the 90° rotation. As line pressure is applied the lip is pushed into more intimate contact with the ball surface and the structural



The rotating member is a sphere located between two non-metallic seats.

design of the seat ensures that no extrusion occurs. The inside diameter of the lip is always slightly larger than the ball port so that no "growth" of the seal occurs to prevent operation.

The general design of the valve caters for (a) automatic take-up of wear and relaxation, requiring no maintenance; (b) choice of seat materials to handle general, chemical and petroleum services; (c) identical upstream and downstream seats which enable the valve to be installed irrespective of direction of flow; and (d) upstream and downstream sealing, which provides the "Double Seal" safety feature.

Jamesbury-Serck Limited, Eastern Avenue, Gloucester.

Plain Words

By Capricorn

THIS week I happened to take down from the bookshelf a volume of the *Review of Reviews* for 1896. It is not my habit to browse through old books but on the rare occasions when I do I usually learn something to my advantage. This was such an occasion. From 1896 to 1961—so much has changed, and yet so little.

It seems to have been about that time that the bicycle was at the height of its popularity. A visitor to the country house of Mr. Balfour has noted two machines in the hall—" for both Mr. Balfour and his sister are devoted to the wheel." The Countess of Malmesbury had written an article " On a Bicycle in the Streets of London," in which she protested that hansom cabbies had found a new sport—that of chasing the lady bicyclists: " the pursuit on wheels of alien wheels surmounted by a petticoat which half conceals, yet half reveals, the motive power within."

Mr. D. G. Hogarth was really tough: he was the first man to take a bicycle into Upper Egypt, and he had described his experience of cycling in the desert. Back home again, the *Country House* " discussed the need of improved hostelries for lady cyclists, who do not relish apparently the pleasant village inn."

The list of events for June, 1896, opened with " Publication of Mr. Blackstone's Letter on Anglican Orders," and included " Celebration of Lord Kelvin's Jubilee as Professor of Natural History in Glasgow University."

Here was Victorian England—solid and respectable—but if you think there wasn't another side to their Victorian natures, or that two World Wars have separated us from them absolutely, consider other extracts.

One writer complained that " peace or war, Russian aggression never stands still." Every issue of the *Review of Reviews* devotes much space to South Africa and the colour problem. The book of the month for June was *Made in Germany*, by E. E. Williams, and the review is headed " The Decline and Fall of British Industrial Supremacy: An Appeal for Instant Action Ere it Be Too Late." Mr. Williams was urging the Government to take immediate action to make our industries more competitive with the diligent Germans. " There is one factory at Elberfeld," he reported, " where not less than 60 trained chemists form a part of the permanent establishment. These gentlemen have well furnished laboratories at their disposal and they receive a regular salary for what the English would call ' doing nothing ' (but the Germans call it ' research ')."

The cure to all this was to be better technical education. In the meanwhile, " Events of the Month " showed that on 9 June the " members of the Institution of Naval Architects arrived in Hamburg."

I do not know, but looking back on those years from 1896 I think the lesson of their visit to Hamburg was not altogether lost on them.

Letters to the Editor

Powered Caravans

SIR, It was with some interest that I read your article on motor caravans (ENGNG., 7 July '61, p. 32).

Unfortunately, it is obvious that this was not written by a motor caravanner, with the result that there were one or two points that did not measure up to the subject. I hope that you will not think it presumptuous if I list some of these points below.

1. While it is true to say that the motor caravan originated in England, there are a number of overseas countries which produce motor caravans, in particular the United States where the industry is quite a thriving one.

2. While you are quite correct in reporting " over a dozen " manufacturers in the business, you will be interested to know that the figure is nearer two dozen, with 27 known to me.

3. You mention that there is an International Caravan Exhibition to be held in September, I would suggest that this is a little out of place for this will be confined to trailer caravans, and no motor caravans will be exhibited.

4. The Hosking company do not use the name " Caravette," but " Sunquest." In fact, there is a conversion of the Volkswagen Micro-bus carried out by J. P. White Limited, of Sidmouth, and distributed by the Lisburne Garage Limited, Torquay, Devon, which has the name " Devon Caravette."

5. You mention that the Bluebird Moto-Plus has a 5 gallon water tank but, actually, these tanks now hold 6½ gallons.

I do hope that you will find the contents of this letter of interest, and would assure you that my only aim is to be of assistance.

Yours faithfully,
W. J. KELLY,
President and Public
Relations Officer.

The Motor Caravanners' Club,
Richmond, Surrey.
6 August, 1961.

Editor's note: " Caravette " was the name originally chosen for the Hosking motor caravan, but this name was later changed owing to the prior claims of J. P. White Limited.

Events in Advance

Investigating Office and Sales Procedures

NON-MEMBERS of the Institute of Work Study are invited, equally with members, to attend the organization's annual conference, which is due to be held at the College of Aeronautics, Cranfield, from 29 September to 1 October next. The important and topical theme chosen for discussion, " The Scope for Investigation into Office and Sales Procedures," should attract a considerable audience.

The proceedings will open with a formal dinner on 29 September, at which Lord Courtown, O.B.E., President of the Institute of Office Management, will be the principal guest. After which, Mr. R. M. Currie, C.B.E., President of the Institute of Work Study, will deliver his presidential address.

On the following day, Saturday, papers will be delivered on " The Fundamentals of Office Work," by Lord Courtown; on " Investigations into Office Work," by Mr. Harry P. Cemach; and on " Work Measurement in the Office," by Mr. R. R. Whitaker of Imperial Chemical Industries Limited, and Mr. J. L. Gilmour of Littlewoods Mail Order Stores Limited. These will be followed by a film display.

On the last day of the conference, Sunday, a paper entitled " Work Study and the Field Sales Force " will be read by Mr. J. O'Shaughnessy of the Work Study School, Cranfield. Conference fees payable by members of the Institute are £6 and by non-members £8. These amounts cover residence and meals. Non-resident visitors to the conference will also be welcome and, in their case, reduced fees will be payable.

The Institute, formerly known as the Work Study Society, was formed to encourage the study, development and application of work study and industrial engineering techniques. They also strive to encourage and maintain good standards of conduct and achievement by persons engaged in this field.

Applications to attend the conference and additional information regarding the Institute may be obtained from the honorary general secretary, Mr. W. G. Neill, 3 Cork Street, London W1, or by telephoning REGent 7669.

Exhibitions and Conferences

Arranged in chronological order.

Ionic Melts, General Discussion on Structure and Properties.—Tues., 5 Sept., to Thurs., 7 Sept., in the Department of Inorganic and Physical Chemistry, University of Liverpool, Vine Street, Liverpool 7. Organized by the Faraday Society, 6 Gray's Inn Square, London WC1. Tel. CHAncery 8101.

Consumer Packaging for Export, Convention.—Wed. and Thurs., 6 and 7 Sept., and Wed. and Thurs., 13 and 14 Sept., in the Pillar Hall, Olympia, London W14, during the run of the International Packaging Exhibition. Organized, in cooperation with the Export Council for Europe and the Western Hemisphere Exports Council, by the Institute of Packaging, Malcolm House, Empire Way, Wembley, Middlesex. Tel. Wembley 8623.

Laboratory Equipment, Griffin and George Exhibitions of.—Tues., 12 Sept., to Thurs., 14 Sept., at the Welsh College of Advanced Technology, Cathays Park, Cardiff; and Mon., 18 Sept., to Thurs., 21 Sept., at Chorlton Town Hall, Cavendish Street, Manchester. Apply to Griffin and George Ltd., Ealing Road, Alperton, Wembley, Middlesex. Tel. Perivale 3344.

Instrumentation for Small Firms, One-Day Conference.—Wed., 13 Sept., at the College of Technology, Ashby Road, Loughborough, Leicestershire. Theme: " The Application of Instrumentation to Industrial Processes." Organized by the Society of Instrument Technology, 20 Queen Anne Street, London W1. (Tel. LANgham 4251.) Apply to the hon. secretary of the Society's East Midlands Local Section: Mr. A. C. Baker, English Electric Co., Ltd., Whetstone, Leicester. Tel. Narboro' 3434.

Standards Engineers Association, Tenth Annual Meeting.—Mon., 18 Sept., to Wed., 20 Sept., at the Hotel Sherman, Chicago, Illinois, USA. Theme: " Standards—Cost Reduction." Apply to Mr. J. E. Stevens, Chicago Bridge and Iron Co., 1305 W. 105 Street, Chicago 43, Illinois, USA.

Institute of Metals, Autumn Meeting.—Mon., 18 Sept., to Fri., 22 Sept., at the Palais des Congrès, Coudenberg, Brussels, Belgium. Offices of the Institute: 17 Belgrave Square, London SW1. Tel. BELgravia 3291.

Electrical Network Theory, Residential Symposium.—Mon., 18 Sept., to Fri., 22 Sept., in the Department of Electrical and Control Engineering of the College of Aeronautics, Cranfield. Apply to Mr. S. R. Deards, Department of Electrical and Control Engineering, College of Aeronautics, Cranfield, Bletchley, Buckinghamshire.

Planning for Traffic, Convention.—Thurs., 5 Oct., at Central Hall, Westminster, London SW1. Organized by the Institution of Municipal Engineers, 84 Eccleston Square, London SW1. Tel. VICtoria 5083.

Smithfield Show and Agricultural Machinery Exhibition.—Mon., 4 Dec., to Fri., 8 Dec., at Earls Court, London SW5. Organized by the Smithfield Show Joint Committee, c/o Society of Motor Manufacturers and Traders, Forbes House, Halkin Street, London SW1. Tel. BELgravia 6611.

Building and Public Works Exhibition.—Wed., 13 June, to Sat., 23 June, 1962, at Whitchurch Air Field, Bristol. Supported by the South Western Federation of Building Trades Employers. Organizers: Advertising Publications Co. Ltd., 20 John Street, Sunderland. Tel. Sunderland 71464.

Three Unconventional Sources of Energy

Of the many under-used sources of energy in the world, three—wind energy, solar radiation and geothermal energy—are recieving serious attention. The subject is to be discussed at a United Nations' conference opening in Rome next week.

By E. W. Golding, O.B.E., M.Sc.Tech., M.I.E.E., M.Am.I.E.E.

The Electrical Research Association

IN THE post-war years there has been a world-wide recognition of the urgent need to develop power production to make up the back-log due to war-time difficulties and to satisfy the very large, and rapidly-increasing, demands of advancing industries. An interesting, feature of the attack on the problem has been the consideration given to "unconventional" or "new" sources of energy. Neither adjective is quite satisfactory but these sources, though not "new" in the sense that they have just become available, are attaining a novel significance as potential providers of power for which purpose they have not been commonly used in the past.

There are many of them—solar radiation, the wind, tidal energy, geothermal and marine heat, wave power, organic wastes and yet others whose potentialities for economic utilization are perhaps less obvious.

There is, of course, no suggestion that such energy sources will ever play a major role in fulfilling the world's power needs but, failing a major break-through in technique which might lead, for example to the development of a simple and cheap nuclear power plant of very small capacity (a few kilowatts), there is likely to be considerable scope for them, particularly in the less-developed countries. In the most comprehensive study of the question published in recent years—P. C. Putnam's *Energy in the Future*—it is estimated that they will be meeting about 11 per cent of the world's energy demands by the year A.D. 2050.

The conventional energy sources vary in their permanence, or exhaustibility; reserves of coal, oil and natural gas are certainly being depleted rapidly whatever assessments may be made of their magnitudes; hydro-power is permanent while, taking the broadest view, nuclear energy may also be considered as inexhaustible. But all have limitations of some kind, whether it be of location—involving power transmission or fuel transport—of cost, or of economic size of plant. On the other hand, reliable power supplies, regardless of time, can generally be provided by such means. The three unconventional sources, geothermal, solar radiation and wind, which are now receiving most attention, differ in that geothermal energy, like the conventional sources, can be depended on for firm power, but is strictly limited, like hydro-power, in location, and is not inexhaustible, while both solar and wind energy are inexhaustible and widespread in availability, without involving any transport of energy, though they are non-reliable in time.

Power plants to harness wind or solar energy have the advantages that they are of relatively small capacity and are simple to operate and maintain. This makes them attractive as power sources for thinly populated under-developed and remote areas but, counter-balancing these advantages are their constructional costs which tend to be high per unit of capacity, because of the "thin" distribution, in space, of their energy input; this means that the physical dimensions of solar and wind power plants are relatively large for a given power output. Again, the non-reliability, in time, of solar and wind energy introduces the question of energy storage to maintain supplies during periods when the sources are lacking. The heavy cost of storage, by whatever means may be adopted, prompts the question "How important is it that a power supply in a remote area shall be continuously available"? or, "Is a somewhat restricted power supply acceptable where the conventional methods, capable of giving full and continuous service, may be prohibitively expensive"?

The main problems to be faced in exploiting such locally available energy resources lie, therefore, in the development of simple and robust power plants at a sufficiently low cost and in the utilization of random power to the fullest possible degree to obtain the best return on the capital outlay. It is in these directions that research on solar and wind energy is proceeding.

SOLAR RADIATION

At the earth's outer atmosphere, the rate of receipt of solar radiation is 1·35 kW per sq. m but, due to absoption and reflection, the maximum recieved at the surface is about 1 kW per sq. m. The annual quantity of energy received from this source is, however, over $1{\cdot}5 \times 10^{18}$ kWh—some 50,000 to 60,000 times greater than the present world annual consumption of energy in all forms. But, in the past, very little use has been made of it, directly, for the production of power. During recent years much research has been done, especially in countries with an abundance of sunshine, in the zone between about 40° N and 40° S latitude, to further practical applications in this direction. This work has received encouragement from the International Symposium on Applied Solar Energy held at Phoenix and Tucson, Arizona, in 1955, and by the subsequent formation of the Association for Applied Solar Energy which coordinates the collection and exchange of information on this subject on an international basis. A significant point in favour of the exploitation of solar energy is that many of the world's under-developed areas, where the present energy consumption is extremely low, lie in the zone having plenty of sunshine.

The possible applications are classified according to whether they use the radiation in the form

The flat plate heat collectors of the "Somor" solar-operated water pump at the Solar Energy Exhibition, Phoenix, USA, 1955.

of heat or as light and they can be listed as below.

Applications depending on heat:—
- Water heating
- Distillation of saline water
- Air conditioning
- Refrigeration
- Cooking
- High temperature furnaces
- Mechanical power
- Thermo-electric conversion.

Applications depending on light:—
- Photo synthesis
- Photo-chemical reactions
- Photo-electric conversion.

Whatever the application, a basic economic difficulty lies in the provision of the collector which must cover a relatively large area with consequent heavy costs, not only for the material itself, but for the means of strengthening it, mechanically, to withstand high wind pressures. To illustrate this, considering if the possibility of installing a solar thermal power plant to produce (say) 1,000 kW in an area where a radiation intensity of as much as 0·7 kW per sq. m can be relied on, the overall efficiency of the collection and conversion to electric power being 5 per cent, the collector surface needed would be about seven acres. A solar steam power station of this size and type, having a collecting surface of 215,000 sq. ft (about 5 acres) has been projected in USSR but has not yet been built. Developments in this direction are, therefore, likely to be devoted to the production of small power units, such as the Italian solar water-pumping plant, using sulphur dioxide as its working fluid and having a capacity up to 3·5 hp; or perhaps they may follow an Israeli conception of collecting heat in "solar ponds" in which thermal convection is reduced by the use of layers of solutions having different densities.

Water heating, distillation, refrigeration and air conditioning lend themselves to the use of small-power installations mainly with flat-plate collectors, the efficiency of which may be around 50 per cent and, for these purposes, the search is for cheaper and more effective materials, e.g. plastics, to absorb the heat, and for better thermal insulation to conserve it.

Concentrating collectors, of paraboloidal or parabolo-cylindrical form, are used in small sizes for cookers and in much larger sizes, built up from small reflecting segments, for solar furnaces to produce temperatures of 3,500° C. Again, there is scope for new materials for the reflecting surfaces.

Thermoelectric conversion, using semi-conductors, may become an economic possibility, on a small scale, if materials can be found to withstand the high temperatures at the focus of a parabolic reflector.

Flat-plate collectors can utilize diffuse radiation and do not have to be continually oriented to face the sun, as do parabolic reflectors which use only direct radiation. The question of devising cheap and effective methods of orientation is being studied by designers of the latter.

Photo-chemical reactions may be found which could assist in the problem of storing the energy from solar radiation.

In photo-electric devices, solar energy is converted directly into electrical energy without any intermediary stage. This is a very attractive prospect but, although a conversion efficiency of 11 per cent to 15 per cent has been obtained, and progress has been made in reducing their costs, the solar cells needed are still too expensive for the method to be followed to produce significant quantities of power. Intensive studies of this problem are being made, especially in USA and USSR, and the increasing use of these cells for space satellites, for telecommunication systems, and in instrumentation may, in itself, lead to a reduction in price through quantity production.

WIND POWER

An essential preliminary to the exploitation of both solar and wind energy is the obtaining of data for the quantities of such energy available at the place where the installation is to be made. Though new types of instruments for the measurement and recording of solar radiation are being devised to provide information in the most usable form, much already exists at climatological stations all over the world. Wind speeds and directions have also been measured by the

The Dowsett 25 kW windmill under test.

national meteorological services for many years, but these speeds refer only to the observation stations themselves.

By taking advantage of suitable forms of terrain, it is possible to find sites, particularly on hill summits, where the annual average wind speed is as much as 50 per cent higher than at the nearest meteorological station. Wind power being proportional to the cube of the wind speed, the search for these especially favourable sites is a matter of first importance; a gain of only 2 or 3 mph in average wind speed can increase the annual output of energy by as much as 25 per cent. This means a substantial reduction in the unit cost of the energy, since the operating costs —almost entirely capital charges—are fixed. Wind surveys are, therefore, being undertaken by all countries interested in wind power development; there is much interest in the determination of the principles to be followed in site selection —wind tunnel tests on models of hills having proved useless—and in devising types of anemometers and recorders suited to survey work in sparsely-populated areas where skilled attention can be provided only at infrequent intervals.

Wind power research, during the last 10 or 12 years, in Great Britain, Denmark, France and Germany, has aimed at the development of wind-driven electric generators, of individual capacities up to several hundred kilowatts, suitable for operation, unattended or with only a little unskilled attention, in relatively isolated areas and for different purposes.

Some of this work, particularly in Denmark, has been devoted exclusively to the design and constructon of large machines connected to electric power networks and serving as fuel savers. In France also, and originally in Great Britain, the research has had the same main object but, during the last few years, more attention has been paid, in both countries, to smaller plants for use by communities established too far from main networks to receive a power supply from them. The German research started with smaller-scale plants and has more recently included larger machines.

The scope for wind-electric machines of smaller capacity, up to 50 kW, is known to be considerable—for community power supplies, for telecommunication systems, for electrical controls of remotely situated plant and for cathodic protection. The problems with such machines arise from the facts that storage of energy in large capacity batteries is prohibitively expensive, and that an autonomous machine, when subjected to widely varying wind speeds, gives an electrical output which fluctuates in voltage and frequency.

Utilization of the power output from winds occurring at random times also creates problems because, for economy, all the energy becoming available must be effectively used, and used without resorting to any large degree of energy storage. Studies are being made, therefore, of methods of distributing the random power, automatically, to various loads which do not demand precise compliance with a time schedule.

The combination of power plants driven from different energy sources may, in fact, produce a more complete service because their characteristics may be complementary, e.g., there may be wind during the night and sunshine during the daytime.

Another problem arises when power plant driven by a rapidly fluctuating power supply is being developed—it is not easy to test its performance, yet some precision in testing is necessary and special testing techniques are therefore being established.

GEOTHERMAL ENERGY

It is well known that the temperature of the earth's crust, in the first few thousands of feet, increases with depth, the temperature gradient varying from 6° F to 30° F per 1,000 feet, according to the thermal conductivity of the layers of rock. Heat is continually flowing out from the surface of the earth at an average rate of about 0·0135 Btu per sq. ft per hour, so that the total annual outward flow is equivalent to almost 2×10^{14} kWh. This represents a continuous power output of some 2×10^{10} kW, but there is little prospect of harnessing more than a small fraction of this power. At certain especially favourable sites, however, mainly in volcanic regions where the thermal gradients are relatively high, or in some non-volcanic areas where there are surface outflows of natural steam or hot water, economic power production from this source of energy is possible.

The largest and best known geothermal installations are at Larderello in Northern Italy. After starting on a very small scale in 1904 they now have a total installed capacity of some 320,000 kW with a further potential of another 100,000 kW. After some ten years of investigation and subsequent construction, 69,000 kW of geothermal generating plant has now been brought into operation in New Zealand. This is the first stage of the Wairakei scheme with an authorized total capacity of 150,000 kW. The second stage is now under construction and a third stage may add a further 100,000 kW.

The construction of the first American geothermal plant, of 12,500 kW capacity, located about 75 miles north of San Francisco, is just being completed. There is a 30 kW experimental station in Japan and a 275 kW station in Katanga. Iceland uses geothermal steam and hot water for domestic heating schemes and for glasshouse heating.

Areas where this form of energy might be exploited economically occur in other parts of the world, including Chile, Argentina, Uganda, Indonesia, USSR, Mexico, El Salvador and Nicaragua.

Conditions differ so much from one geothermic field to another that it is difficult to formulate any single theory to explain fully the phenomena occurring. A simple, though very incomplete, explanation for the emergence of geothermal fluids—mixtures of steam, gases and hot water—is that the surface water seeps down through deep fissures in the earth's crust and becomes heated by contact with the hot rocks below. But this is only one of a number of theories; until greater experience has been obtained as the result of many investigations now in hand by organizations interested in geothermal development, there can be no certainty in such explanations.

The fluids vary in chemical content, as well as in their physical state; there are possibilities—which have already been exploited in Italy—of using the boric acid, sulphur, ammonia and other chemicals, which may be present, to improve the economy of the power production. This economy is also variable and depends greatly upon the nature of the rocks and sub-soils. Before a field can be exploited, very thorough geological, geophysical and geochemical explorations must be made and, if favourable environmental conditions are found, these are followed by exploratory drilling of test bore-holes. The bore-holes may descend to 5,000 or 6,000 feet and may cost £10 to £30 per foot, so that any new methods of discovering what lies beneath the ground surface have a prospect of saving considerable sums of money.

DEVELOPMENT PATTERN

The three unconventional sources of energy discussed are not alike in the problems which their development presents. One can distinguish between them, in this aspect, fairly readily. The development of geothermal energy calls for capital expenditures of a major order—for preliminary surveys and explorations, for the drilling of the production boreholes and for the construction of surface plant, which is likely to be costly, whether it be for power generation or for heating schemes. Once developed, however, the use of the energy from a geothermal source can follow conventional lines; it is a "firm" source of power like coal or oil-fired, or hydro-electric stations.

At least for some years, it is unlikely that solar energy will be used for power generation on any large scale. Solar equipment, with the exception of solar furnaces, is basically small-scale with an output, whatever its form, equivalent to kilowatts rather than hundreds, or thousands, of kilowatts. It can be installed and operated by local, relatively unskilled, labour and the cost of individual units will lie within the reach of the village dweller, or of the community which could use it communally.

Much the same applies to wind-power plant which, again, is likely to be mainly of small capacity. Fairly large wind-driven generators, like those already mentioned, having individual capacities of hundreds of kilowatts, could be used as fuel savers if connected to existing networks. Developments should be aimed at increasing the size and scope of these small machines to render them more useful for communities in remote areas and for the maintenance of equipment, e.g. oil pipelines or telecommunication systems, running through such areas and needing small supplies of power.

The question of combining the operation of plants driven from different energy sources such as wind, solar radiation, organic wastes, and small water power (or oil-engine) sets deserves attention, because it may well be that this could lead to a more effective or more economic service to a remote community, than the use of any one of the sources.

The provision of a cheap method of storing energy presents a continuing problem that is likely to remain with us for some time to come. There is no sign of any immediate solution to it and, for the present, the best that can be done is to avoid the need for storage, as far as possible, by arranging for the automatic utilization of random energy for useful purposes.

Geothermal power house at Wairakei, NZ.

Zaporozhets with Air Cooled V 4 Rear Engine

The recent Soviet exhibition in London gave British engineers their first opportunity to examine the rear engined Zaporozhets, the new Russian baby car. It has now been in production for nearly eight months, and Russian officials said production is proceeding at the rate of 30,000 a year and the price is 1,800 roubles. In general dimensions and layout the car recalls the Fiat 600. The independent rear suspension with single semi-trailing wishbone and coil spring slightly ahead of each drive shaft is very similar to that of the Fiat and the handbrake, gear lever, starter and choke controls are mounted in the same way on the centre tunnel. Under the front

The Russian Zaporozhets mini car.

bonnet are the fuel tank, comprehensive tool kit and spare wheel. The front suspension is very similar to the Volkswagen, with transverse torsion bars, twin trailing links on each side and telescopic dampers. Some of the prototypes had a Flat Four air cooled engine at the rear with the appearance of a scaled down Volkswagen but this power unit was abandoned.

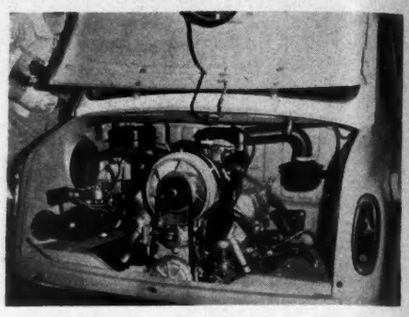
The engine in the production version is an air-cooled 90° V-4 of unusual design. The finned cylinders are spigoted into a light alloy crankcase to which is bolted a shallow finned sump and the separate cylinder head castings are pulled down on to cylinders by long through bolts. The valves, in-line in inverted bath-tub combustion chambers, are operated by pushrods and rockers from a central camshaft which is gear driven directly above the crankshaft.

The four-throw crankshaft is carried in three main bearings and has balance weights to deal with the reciprocating weight of the pistons. In this form the engine has a residual horizontal couple which is ingeniously counterbalanced by a separate gear-driven shaft with bob weights at each end revolving inside the hollow camshaft. The gears for the camshaft and balance shaft are both at the rear of the engine and on the extreme end of the crankshaft is a fan pulley which incorporates a centrifugal oil filter similar to those used on Fiat cars. This pulley drives via a V-belt dynamo round which is a cast light alloy cooling fan drawing air over the cylinders and over an oil cooler mounted at the forward end of the engine. Cool air is delivered to the engine compartment through louvres in the sides above the rear wheel arches and warm air is forced out by the cooling fan through a small hole in the hinged engine cover at the rear.

A single downdraught carburettor in the centre of the V supplies the four cylinders through a cast manifold. Fuel is drawn from the 6·6 gallon tank by a mechanical pump. An exhaust pipe from each cylinder merges, into two pipes leading to separate silencers, one on each side of the car. The engine is an over-square unit with bore and stroke of 66 × 54·5 mm (746 cc). On a modest compression ratio of 6·5 to 1, designed to deal with low grade fuels, it produces 23 bhp at 4,000 rpm. Maximum torque is 32·5 lb at 2,400 rpm. In unit with the engine are a single-plate clutch and a four-speed all-indirect gearbox which is mounted ahead of the spiral bevel final drive and differential. The gearbox has synchromesh on the top three ratios and one pair of gears is overhung on the ends of the shafts beyond the forward bearings.

The brakes are hydraulic and self-adjusting. The wheels are simple light rims secured by four bolts to spiders integral with the brake drums. The polished nave plates covering the brake drums are secured by three small and vulnerable looking set screws. Tyres are 5·20 — 13 and the wheelbase is 79·6 in.

In its structure and mechanical parts the car seems to be robustly dimensioned and it has a good ground clearance. Paintwork is good and the upholstery is of simple design in a combination of cloth and plastic sheet, a fluffy cloth head lining and moulded rubber floor covers. The two-spoke steering wheel has a rather prominent projecting hub. Grouped in a small



The petrol burning heater with a small gravity fed fuel tank is on the left of the V 4 engine.

casing in front of the driver are the speedometer with total distance recorder, fuel gauge and warning lights for oil pressure, oil temperature, headlamp high beam and direction indicators. The rear seat backrest folds forward to make a luggage platform.

A particularly interesting feature of the car is a powerful petrol-burning heater designed to cope with the extremes of the Russian winter. It lies in the engine compartment and draws air from the cool air intake in the rear wing, passes it over a heat exchanger and delivers the hot air by means of an electric blower to the interior of the car. Fuel is fed to the burner by gravity from a small auxiliary tank inside the engine compartment which is replenished by the engine fuel pump. The fuel is ignited electrically and combustion products are discharged through a pipe underneath the car.

Kerb weight of the car is quoted as 1,430 lb and the fuel consumption 51 mpg. Maximum speed is given at 56 mph.

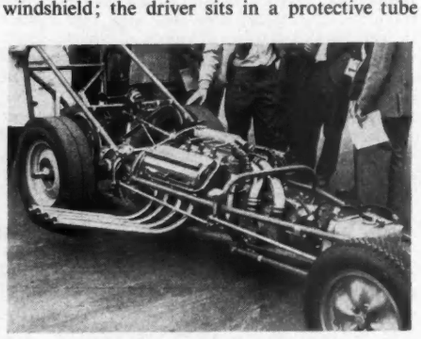
Allard's American Style Sprint Car

Sydney Allard recently demonstrated his new dragster at Silverstone, which is the first British-designed version of an American sprint car. Work started at Allard's workshops last January under the supervision of John Hume, development engineer, who was formerly chief racing mechanic with Coopers. The car was designed by David Hooper, Allard's chief designer, under the supervision of Sydney Allard and the design as been adapted to fit Allard's measurements.

The Allard dragster has a Chrysler V8 engine of 5,803 cc (354 cu. in) mounted well towards the rear of the light tubular frame. It is supercharged by an American Root's type blower driven from the front of the crankshaft (later to be replaced by a British Shorrock for which Allard is the agent) and methanol fuel mixture is injected into the blower intakes by a Hilborn pump driven from the front end of the blower. Ignition is by a Scintilla magneto mounted vertically at the rear of the engine. The compression ratio is 8 to 1 and the supercharger delivers at pressures up to 20 lb per sq. in (1·4 kg per cm) above atmospheric. Maximum power is 480 bhp at 5,000 rpm and the peak torque 550 lb-ft at 3,000 rpm.

Transmission is through a Schiefer 11 in diameter clutch and a two-speed manual gearbox. There is no rear suspension, the rear axle being bolted direct to the frame, and there is no propeller shaft: the drive passes from the gearbox to the differential, which is a conventional non-locking unit, via a pair of Allard quick-change transfer gears at the rear. The gearbox has only two ratios, direct and 1·61 to 1. Available final drive ratios are 2·8 and 4 to 1.

The front axle beam is shackled to a light transverse leaf spring and located by two longitudinal radius arms. There is no bodywork or windshield; the driver sits in a protective tube



Allard "dragster" using a Root's supercharger and a Chrysler V 8 engine. A cylindrical header tank is used without a radiator.

cradle just behind the axle, with his knees above the axle. The steering wheel is spectacle-shaped and the tachometer acts as a small wind deflector in front of the driver's face. Front brakes are discs of 9¾ in diameter and rear brakes are drums 12 by 1¾ in. Front tyres are Dunlop racing 5·25-15 and at the rear are American slicks 8·00-16.

In good weather conditions Allard did nine runs over a standing quarter mile at Silverstone up a fair gradient; his best time was 9·5 sec. The highest speed was on the seventh run when the car covered the final 50 yd of the quarter mile in 0·6 sec at approximately 160 mph. Latest information from America shows that records for the standing ¼ mile and the highest finishing speed stand at 9·0 sec and 174·4 mph respectively, which have been obtained after four years experience.

Allard's idea in building the car is to investigate the possibility of introducing the American-type sprint sport into England.

Allard was doing 140 mph on the hill after the end of his first run when he found two large sows sauntering across the track in front of him, followed by two herdsmen from the Silverstone farm. Unable to stop, he passed within a few feet of them at about 120 mph. Concern was later expressed for the "valuable animals" by the herdsmen as one was in pig.

Human Element

How Accidents Can Happen

THE latest issue of the Ministry of Labour's quarterly, *Accidents—How They Happen*, gives a big coverage to accidents involving materials handling and transport. In particular, it is concerned about the fact that, in spite of the increase in mechanical handling, over a quarter of the 160,000 accidents reported each year occur during manual handling of goods and materials. Often, this type of accident has relatively simple—and therefore easily avoidable—causes.

Advocating the use of safety helmets, the booklet quotes the examples of men who were saved from death when hit by a 14 lb magnesite brick falling 20 ft and by a 100 lb steel plate falling 9 ft. It is reassuring to hear that the prejudice against the wearing of protective headgear among operators is declining—a trend which the booklet links with the success of the campaign to popularize motor cycle headgear—but there is still a long way to go in educating industrial workers to accept the necessity for such protection. After all, no one ever thinks it can happen to him, or her, until it does.

One part of this problem—not mentioned in the booklet—is the problem of persuading female operators that they can remain seductively feminine while wearing protective headgear. Recently, a well known motor components manufacturer introduced in his factory suitable hats, in a varied choice of colours, to guard against the possibility of flowing locks being caught up in machinery. Instead of being grateful, most of his girl operators asked for their cards. If only some film star would set this fashion.

Incorrect Lifting

The booklet also draws attention to the fact that about a third of the accidents during manual handling involve injuries to the trunk, largely because of incorrect lifting and carrying of loads. It is not always understood that the leg and thigh muscles are stronger than those in the back and abdomen, and so should be used in lifting, keeping the back erect and the arms straight. There are some very good training films illustrating this point. HM Factory Inspectorate have also prepared an illustrated booklet and a coloured wall chart showing the risks to workers.

The increase in transport accidents, especially non-rail accidents, has come with the increased use of transport vehicles and, the booklet suggests, presents new problems to factory managements. With existing factory layouts, vehicles unsuitable in size and manoeuvrability are often used, sometimes because the transport was introduced after the layout was established.

This possibility of thoughtlessly introducing an element of danger when adapting existing equipment is also brought out in the section dealing with process machinery. There is the example of a woodworking machinist who, when using an overhead planer for a moulding operation on a rush job, injured the middle finger of his left hand so severely that it had to be amputated. Sometimes, too, machines which are designed and constructed for service in one industry are found to be serviceable in other industries where, it is often overlooked, the hazards are very different.

From these and other types of accident quoted in the booklet it seems that accidents fall into two basic categories—those which are inherent in bad working methods and those which arise from a failure to use protective equipment on either machinery or the operator. Both types are a product of bad management and supervision, but the operator also has a personal responsibility to guard against the latter type.

Industrial Training Council's Second Report

The Second Report of the Industrial Training Council, covering the council's activities from January 1960 to March 1961, has now been published. In recent months, the council's work and influence have been extended by the appointment of regional committees, and this second report includes brief accounts of the steps taken in 36 industries as a result of joint action with the appropriate employers' organizations and trade unions. The accounts from these different industries make mixed reading.

For example, the Atomic Energy Authority continues to take advantage of the increased number of "bulge year" school leavers and, it is anticipated, the Authority's intake of apprentices will become stabilized at something like 25 per cent above the 1957 figure. Less specific increases in training and numbers are reported and forecast from electric cable manufacturers and from the chemical and civil engineering industries. At a minimum, the National Coal Board plans to recruit about 16,300 boys, including 3,000 apprentices, during 1961—a 40 per cent increase on the 1960 figures—and for each of the next few years expects to take on 18,000 boys, 3,000 of them as apprentices.

In the electrical contracting industry, a new apprenticeship scheme, with central registration and categories for both indentured and non-indentured apprentices, came into operation early in 1961. During the year, the Engineering Employers' Association have appointed training development officers in the Scottish, North-East Coast and Sheffield Association areas, in addition to those already operating with the London, Birmingham, Coventry and West of England Associations. Work has been carried out on schemes for both apprentice and non-apprentice training, and area and joint local training committees are keeping training and recruitment under constant review.

Catalytic Effect

The Council has also cooperated with the Gas Council and with the Heating, Ventilating and Domestic Engineers in drawing up suitable training programmes. In the iron and steel industry there were 20·7 per cent more young people in October, 1960, than there had been a year earlier, and a number of new apprentice training centres were opened. A less encouraging account comes from the Shipbuilding Employers' Federation. Understandably perhaps, they do not expect to increase their 1961 apprentice intake above the level of the previous three years.

On balance, it does seem from this Second Report that the Industrial Training Council is having the desired catalytic effect on industry and has progressed towards attaining both its short-term aim (not so short-term, it now seems) of dealing with the bulge and its longer term aim of helping to improve training throughout industry.

West of England Apprentice School

A new apprentice school was opened at the Gloucester works of Permali Limited last month by Mr. Lawrence Robson, chairman of the company.

This new apprentice school will play an important part in engineering training in an area that is already comparatively progressive in this respect. Nearby firms who also have their own apprentice schools include T. H. and J. Daniels, the Dowty Group, Fielding and Platt, and the Hucclecote factories of Hawker Siddeley. Other local firms also have comprehensive apprentice training, some of it through the group apprenticeship scheme run by the Gloucestershire Industrial Education Association.

Speaking directly to the apprentices, Mr. Robson reminded them that, for a century or more, when British industry had set its mind on a project—whether a particular export market or an industrial objective—it had usually shown the way to the rest of the world.

He told the apprentices that one day they may be the boss. The new school had been built to encourage them to create, to give them an opportunity to become industrial craftsmen and to help them develop themselves by their own efforts.

Mr. Robson concluded by saying that the new School had been built for the men upon whom the company would depend in the future, to help them lead fuller and happier lives.

Comparison with USA Need for Engineers

Following on President Kennedy's Science Advisory Committee's recommendations of last November, a recent survey by the National Science Foundation of Washington DC indicates that trained scientists and engineers are "a scarce resource" which the United States must develop greatly in the next ten years.

The survey is more sanguine, perhaps, about the available numbers of potential students than about the financial backing which will be necessary to support this increase—though, on the question of student numbers, the report notes that the USA must make its world impact by concentrating on quality rather than quantity because of the anticipated growth in world population compared with that of the USA.

During 1961 the USA invested, from all sources, $3,000 million in college and university scientific teaching and research. This figure, the report declares, must increase to 8,200 million in 1970, for universities need help to overcome their existing deficiencies in laboratory equipment and buildings (the current expansion in higher scientific education is already widening the gap between the needs of research and education and the national investment required to meet these needs) before staffing up and equipping for the further expansion needed in the next decade.

If the National Science Foundation's estimate of scientific and engineering requirements is accepted, and if the necessary funds are made available, by 1970 there will be twice the present annual output of 6,600 doctorates in science and engineering. There is no significant danger, it seems, of such an increase "poaching" talent from other jobs and professions because, at present, of the top 1 per cent intelligence bracket in the immediate-graduate age group, only one in twenty people now get doctorates in science and engineering.

In the USA, as in this country, it appears that the necessary growth in quality and numbers of scientists and engineers is more likely to be inhibited by a shortage of laboratories, equipment and staff than by the supply of potential good scientists and engineers.

However, before we draw too much solace of the "we're all in this together" type from the NSF report, we should remember that there is a marked difference of degree between the American and the British positions. According to another source, the USA is already producing seven times as many scientists and engineers per million of population as we are in this country. Our figure is roughly comparable with that for Yugoslavia and is about half that for Canada and a third that for Russia.

Even allowing for differences in definition and standard of "scientists" and "engineers" this is a frightening position. One cannot help thinking that our predicament is partly a question of distorted priorities when, for example, the total Government grant for all purposes to all universities amounts to less than the egg subsidy.

GEC Engineer Wins Birmingham Scholarship

Mr. Peter Frost, personal assistant to the manager of capacitor division at GEC's Telephone Works in Coventry, has been awarded a travel scholarship from the Department of Electrical Engineering at the Birmingham College of Advanced Technology. Mr. Frost joined GEC in 1955 as a student apprentice and undertook a sandwich training course. As a result of this course, he recently received a Diploma of Technology, and is an Associate of the College.

Mr. Frost hopes to use the scholarship to study the manufacture of electronic components, management organization and technical education in various countries in Europe. The scholarship is awarded annually and this year is worth £90.

Deputy President of the Students' Union during his final year at College, Mr. Frost is a graduate member of the Institution of Electrical Engineers and a member of the Committee of the Student and Graduate Section of the I.E.E. South Midland Centre.

Land Drainage Brings Dual Improvements

A major drainage scheme for farming land in NW England has brought immediate relief from flooding and will provide controllable conditions for agricultural operations.

THE River Crossens catchment area forms a rough semicircle of five miles radius centred on Southport, which is built on a strip of sand dunes and alluvium on the coast of Lancashire in North West England. Landwards from this coastal strip is a low-lying basin, formerly a lake or mere, the natural outlet from which was at Crossens; the present drainage channels, most of which are artificial, also converge on this point. Much of the land surface is below the level of the highest tides, and it is believed that the sea occasionally broke into the freshwater lake. Rapid run-off from the high ground at Ormskirk and from the built-up area of Southport and Birkdale have aggravated the drainage problems.

In 1958 a land drainage scheme was begun which affects about 32,000 acres of rich farming land. This scheme, which has included construction of a pumping station able to handle 450 million gallons per day and the excavation and disposal of a million cubic yards of spoil to enlarge the channel system, will be finished this coming autumn at a cost of £1 million. The responsible authorities are the Lancashire County Council and the River Crossens Drainage Board; and the scheme has been devised and supervised by C. H. Dobbie and Partners, consulting engineers, of Westminster, London.

PREPARATION FOR EXTENSIONS

Since the first channel was cut at the end of the 17th century, the principal stumbling block to satisfactory drainage has been the mud and silt of Liverpool Bay which has consistently choked the outfall channel across the saltings, and in fact the accumulation is now such that the foreshore from high to low water is some four miles across. Originally the whole area was drained by gravity to the Crossens Channel at Crossens, and this arrangement worked until approximately the middle of the last century, when steam pumps were installed there. Since then the central area of about 7,000 acres has been drained by pumping, though the two areas on both sides of the central area—one known as Three Pools and the other as the Sluice—were still being discharged by gravity. The total area of both " wings " is about 16,000 acres.

The surface of the mere is well covered by a thick carpet of impermeable peat formed by the vegetable and woody growth from the swamp. As the drainage scheme was put into operation, and particularly as cultivation took place, the level of the ground dropped steadily. Hence the benefits obtained from the various schemes that have been started have lasted for only a limited period; the same applies to the new scheme, but positive steps have been taken now to simplify the next stage, which will probably be due in 30 years time.

As a result of the factors mentioned above, the area has been subjected to severe and frequent flooding, and it was decided that the whole area of about 23,000 acres should be pumped, though provision for some gravity discharge has been retained. The total area to benefit, however, is about 28,000 acres. A major factor in the scheme has been the careful phasing of the work during the changeover from the old pumping station to the new.

The scheme comprised three main sections:

1. The cutting of a channel about 4½ miles long, to improve the drainage of the central area which has been pumped for more than 100 years.
2. Widening and deepening of the main channels in the Three Pools system and those of the Sluice system.
3. Construction of the new pumping station capable of draining both wings and the central area.

The work in sections 1 and 2 has necessitated underpinning 25 existing bridges, building 35 new bridges, and reconstruction of the underdrain which drained the low-lying lands to the centra systems below the main rivers on both wings. In many cases these underdrains had to be lowered to permit the deepening of the channels and considerable use has been made of thrust boring. For example, a 140 ft long steel pipe of 3 ft diameter was driven under the main Preston Road in a matter of days without inconvenience to the road users.

The design of the new bridges has varied according to span, location and duty, but all of them will be able to take Ministry of Transport normal loading. Holmpress 14 in diameter bored piles, penetrating 7 ft into the marl, have been used for many of the foundations but precast concrete and steel box piles have also been used. Deck widths of bridges on farm roads are 15 ft except where they served only individual fields when they were made 12 ft wide. Usually the deck has been supported by *in situ* T beams, of reinforced concrete for spans up to 32 ft and prestressed concrete for the longer spans up to 56 ft. Some precast RC beams and soffit units were used for remote farm bridges with advantage.

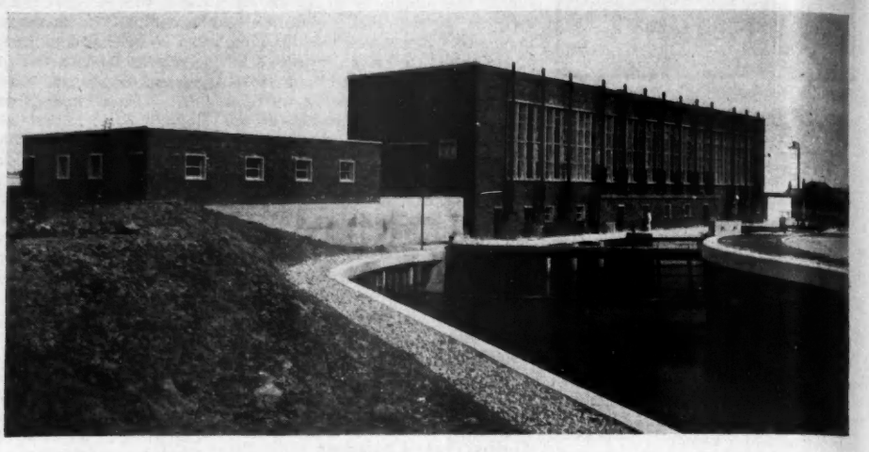
BRIDGING COSTS

The cost of bridge works, including piles, abutments, beams, and deck has worked out roughly as follows:

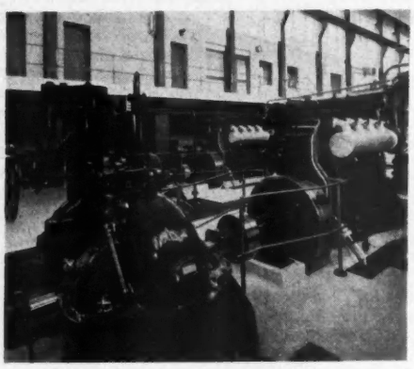
	Cost per sq. ft of deck
Prestressed farm bridges, 46 ft to 56 ft span	£3 0*s* 0*d*
Reinforced concrete bridges up to 32 ft span	£2 10*s* 0*d*
Farm bridge on slab abutment up to 26 ft span	£2 10*s* 0*d*

As just noted, a feature of the scheme is that the pumping station and the bridges have been built to allow for future deepening of the channels when the gradual shrinkage of the peat makes this necessary. Underpinning existing bridges has proved to be an expensive and hazardous job, owing to the difficult ground conditions and the need for the new channel bed to be well below the existing abutment foundation level. The pumping station has also been constructed to allow for a future increase in its capacity, should this be considered necessary.

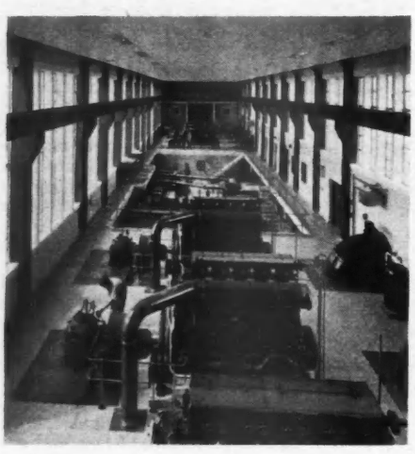
The pumping station, which is illustrated on this page, is 180 ft long by 40 ft wide by 60 ft high from the foundations. Its substructure is founded on a raft of reinforced concrete, protected from the gypsum in the triassic marl by high alumina cement concrete, surfaced with bitumen. The superstructure, including the 10 ton gantry crane, is supported on a heavy factory-made precast concrete portal frame, the cladding being of Accrington multi-coloured



The Crossens pumping station, showing one of the weed screens on the Three Pools side.



The lower pumping floor which will handle the run-off from the central area. Of the seven sets, five were brought from an older station and two are new.



Interior of the station. The sets at both ends will handle water from the " wings " of the area.

First Use of Standard Section Concrete Bridge Beams

The first bridge to be built with prestressed concrete beams of the standard section designed by the Prestressed Concrete Development Group has been constructed by the Central Electricity Generating Board, to provide access over a main drainage channel to their major substation which is being built at Whitson, near Newport, Monmouthshire. Details of the standard section beams, and the expected advantages to be obtained by their use, were given in ENGINEERING for 23 September, 1960, p. 412. The illustration shows the standard sections being moved into position.

The bridge was designed to have a clear span of 46 ft to allow for future widening of the drainage channel. The design load was based on the heaviest expected weight to cross the bridge, a 165 ton transformer.

The original plan was to construct a prestressed concrete bridge *in situ*. However, circumstances made it impossible to complete such a bridge by the delivery date for the first transformer. It was therefore decided to use precast prestressed beams, and to cast the deck slab *in situ*.

Since sub-strata conditions were poor, it was necessary to drive 40 ft pile foundations for the reinforced concrete abutments. The simple bridge bearings consisted of bull-head rails on each abutment, with a flat steel plate let into the underside of the beams.

It was impossible to launch the beams into position from the side, since this would have obstructed an existing public road. A temporary bridge was therefore built, on to which the low-loader delivering the beams could be driven. Two cranes, one on each abutment, together lifted the beams from the low-loader and placed them in position. The unloading and placing of each beam took approximately five minutes.

The contractors were A. Jackaman and Son Limited, 9 Bath Road, Slough, and the precast beams were made by Anglian Building Products Limited, Lenwade, Norwich.

Putting the standard bridge beams into position. The cross-section is clearly seen.

Aluminium Deck for Rolling Lift Bridge

The Scherzer rolling-lift bridge in Kingston-upon-Hull, probably the largest road bridge of its type yet built, has an aluminium deck. The Drypool bridge, as it is known, was designed in the city engineer's department and fabricated by Samuel Bulter Limited. It replaces a " bobtail " swing span which served at this crossing from 1888 until work started on the new bridge in July 1959.

The new bridge has a span of 105 ft and an overall width of 70 ft. A road width of 45 ft, compared with the 15 ft 9 in on the previous bridge, will do much to improve the flow of traffic through the city. The bridge has also been designed with fast operating speeds to minimize the delay when it is lifted. The structure, which weighs 1,400 tons, can be raised or lowered in either 1¾ minutes or 2½ minutes.

Aluminium was considered for the bridge decking both for the obvious need to keep the weight of the bridge as low as possible and for the metal's durability. The 40 tons of aluminium plate and section were all supplied by Alcan Industries Limited who claim that the deck can confidently be expected to have alonger life than alternative materials and also to effect savings in maintenance.

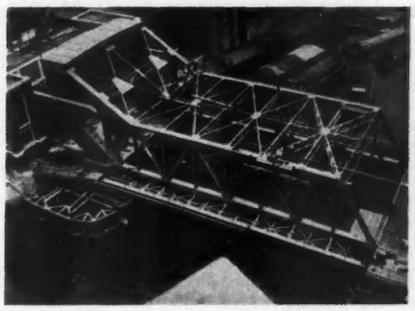
The decking is arranged in eight transverse bays between steel cross-girders. Each bay is made up of five prefabricated panels measuring 9 ft 0 in by 11 ft 6 in. The weight of each panel is only about 2,000 lb which reduced handling problems during erection.

To make the most of aluminium's durability, additional protection has been provided by painting all the aluminium components with a bituminous paint. Strict attention has also been given to preventing bi-metallic corrosion where steel and aluminium are in contact.

A 1 in deep aluminium hexagonal mesh is laid on the deck as a key for the road surface. This surface is a hard laid mastic asphalt in two layers: the first, of pure asphalt, fills the mesh, while the second layer, which has pre-coated chippings rolled in, brings the surface depth to 2 1/16 in.

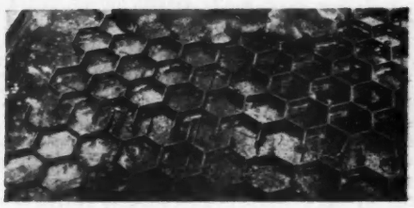
Aluminium has also been used for the hand-railings which have been made from extruded rectangular bars welded together.

Alcan Industries Limited, Banbury, Oxfordshire.



(*Left*) *The Drypool bridge, a rolling-lift bridge with an aluminium deck.*

(*Below*) *The asphalt topping to the deck is held by 1 in deep mesh.*



Concluding **Land Drainage**

rustic brickwork, exposed Criggian granite aggregate panels and purpose-made glazing. The almost flat roof is asbestos cavity decking.

Langley fully vitreous ceramic tiles have been used on the upper pump floors and a combination of Terrazzo tiles and *in situ* work, each containing an iron non-skid unit, has been used on the lower pump floor as the areas of the infilling are more complicated.

PUMPING ARRANGEMENTS

Three 42 in diameter axial flow Gwynnes pumps, each having a capacity of 105 cusecs (56,700 gallons per day) against a head of 12½ ft. at each end of the building will handle the water from the Three Pools and Sluice channels. These pumps are driven by 300 hp five cylinder Ruston diesel engines. A central lifting gate can be used to divert water from either channel to any of the pumps, yet water levels in the two channels can be retained at different levels if desired. The pumps discharge through syphons to above high tide level.

On the central lower floor of the station there are seven 24 in diameter centrifugal pumps of 30 cusecs capacity, driven by 125 hp four cylinder diesels, to serve the middle drainage area. All these sets are of the same pattern and made by W. H. Allen of Bedford. The working head is 16 ft maximum. Two of the sets are new and the other five have been brought from the old pumping station. Penstocks fitted to each pump prevent backflow and discharge is by individual delivery pipes. As space is very restricted, pump suctions had to be carefully positioned to obtain good hydraulic conditions in the sump and the manufacturers carried out model sump investigations to determine the optimum arrangement of plant and the most suitable shape for the sump and inlet channel; the same tests made it possible to predict the level at which air entrainment would commence at different rates of pumping.

The widening and deepening of the channels has involved the excavation and disposal of one million cubic yards of spoil, mainly silt and peat. The farmers and other land owners have been most accommodating and much of this material has been spread over the fields by bulldozers to a depth of 4 in. The lime content of this silt has already had a beneficial effect on the crops in most areas.

Following the improvements in the main drainage systems, further minor schemes may have to be undertaken to effect local improvements and, indeed, the local farmers, with the aid of Ministry grants, are carrying out an increasing amount of tile drainage work.

The value of the works to the area is difficult to assess, but the known direct losses due to flooding were £140,000 in £954 and £200,000 in 1956. Almost certainly the area was spared flooding that would have occurred during last autumn and winter. But the long term value of the scheme will lie in the provision of better and more controllable working conditions for agricultural operations.

Consulting engineers: C. H. Dobbie and Partners, 58 Victoria Street, Westminster, London SW1.

Plant Manufacturers: W. H. Allen Sons and Company Limited, Queens Engineering Works, Bedford; and Gwynnes Pumps Limited, Wellington Foundry, Lincoln.

Civil Contractors: Norwest Construction Company Limited, Litherland, Liverpool 21; Costelloe and Kemple Limited, Cheltenham.

Accuracy in Engineering Advertising

Is it wrong to "re-design" a machine to eliminate or conceal a competitor's component? The author condemns this along with several other malpractices.

by Philip H. Smith, A.M.I.Mech.E.

AT THE time of the Coronation, a world-famous film company inserted a full-page advertisement in a widely-circulated periodical. The theme was naturally the enterprise of the company in its rapid coverage of an outstanding event. The main feature was a magnificently-executed drawing. All were there, the gates, the coach, the serried ranks of cavalry and Guardsmen; the packed crowd, parting a little to let through a running Boy Scout bearing the precious film packages. And in the foreground —alert to rush the burden to the studio, a crash-hatted motorcyclist, with arm oustretched.

The whole of the transmission system of the motorcycle was on the wrong side of the machine.

The foregoing is a true story. Various reactions to the telling of it are not without significance in many ways. A common one, from the unsubtle and uncritical, is "Does it really matter?"

Well—does it? In the first place, we have to consider the ethical viewpoint. A drawing such as described costs a great deal of money; many are the work of artists of a status warranting their signature thereto. It is surely important that every detail be right, even if it is "only a motor-bike"; references are readily available for checking even the minutest detail.

Next comes the thought that such an advertisement must have been passed at a high level of senior management at the firm; no doubt several individuals of various grades had a say. But perhaps, here is a hint of Professor Parkinson. The office-boy, had he been consulted, would have noticed the prominently-displayed faulty motor-bike; while if the much less obtrusive Guardsmen had been wearing berets or slouch hats, there would have been pandemonium in the board-room.

This does not lose force because the illustration appeared in a non-technical magazine. Mechanical subjects are nowadays a part of life, and have just as much claim to accurate portrayal as old castle gates, pastoral scenes, or shows of domestic bliss. If it is accepted, as it must be, that advertising allocations give value for money, it must likewise be evident that the effort put out by those concerned is done in reasonable hope that their creation will be looked at, and not just passed over. Obviously, copywriters and commercial artists enjoy the creative side of their work; but the ultimate end in view must be to hold the reader's interest so that he takes in everything there is.

ELIMINATING COMPETITORS

Advertising directed at engineers—not only in engineering journals but also in serious newspapers and non-technical weeklies—should be based foremost on accuracy of statement and illustration, and the avoidance of anything implying that the reader is assumed to be ignorant of basic engineering principles, current practice, and general trends. As far as illustrations are concerned, the example already quoted makes the point in a very obvious way, because the mistake in itself was obvious. But when more intricate machinery is involved, the scale of accuracy depends not only on the general style of the advertisement, i.e., how "free" it is, but also on what is being portrayed. For example, a combine-harvester could be shown quite unmistakably by an artist using a dozen-odd strokes of his pen. If showing a close-up of a specific mechanism such as a gearbox or control device however, it is important that the surrounding items are also accurate.

While the camera cannot lie, the results are capable of being twisted beyond recognition in their passage to magazine illustrations. Such "retouching" is valuable if used to emphasize otherwise obscure details, but in the process it sometimes happens that essential parts become altered or even obliterated. When done accidentally, this can be remedied by competent scrutiny at the appropriate stage. More reprehensible is the not unknown practice of focusing attention on one's own product by eliminating anything savouring of a competitor's.

"RE-DESIGNING" MACHINES

One might for example manufacture a type of friction clutch, which is photographed on a large machine also employing several other clutches of a rival make. The machine is "re-designed" to enclose these, or even to remove them altogether. The result is that the machine no longer resembles any known example, and the subterfuge is obvious to engineers who have experience of it; respect for the advertiser is thereby lessened.

Drawing in a "free" style can be entertaining as well as interesting to the viewer, but is also full of pitfalls. There is a considerable amount of plagiarizing in this field, and though one might react favourably to some unorthodox treatment of a refrigerator, boredom will have set in by the time a similar style has been seen on office furniture, houses, motor-cars, and machine tools. Occasionally, "bloomers" are made deliberately, and if part of a well-established custom with a humorous background, can be justified. Occasionally, however, it is difficult to decide whether these errors are deliberate or not. Recently, for instance, a company producing "essential liquids" for road vehicles displayed in the newspapers a "free-style" engine having its four-cylinder crankshaft arranged "up-down-up-down." Certainly, it made one look again, and it is almost, though not quite, incredible that such a mistake could be genuine. The objection is that much of this advertising is aimed at educating the ordinary motorist in the workings of his engine, and one can only guess at his bewilderment when comparing such an illustration with all he had already learned.

The copywriter has to steer carefully. To the agile mind, captions and slogans of telling quality come quickly. Unfortunately many of the latter that reach the press bear the stamp of Higher Authority intervention which, however estimable in its specialized field, sometimes lacks the freshness of outlook, or a sort of courage to depart from the strictly "done thing." Hence, once again, copying is rife. Plays on numbers, and letters of the alphabet; phrases like "From first to last," or "Top people use—" do their orbit of the journals, and constantly recur. (Incidentally, the same characteristic is evident in naming a product. The number of titles ending in the word "Master," from toasters to heavy commercial vehicles, which have appeared in the past ten years, defies enumeration.) The stilted phraseology of design and drawing offices is almost invariably out of place, but nevertheless, when interpreted for a wide readership, technical accuracy must not be sacrificed. Some chief engineers object strongly to what they term playing down the technical aspect, and in some advertisements can be seen ample justification for such caution. It is, however, not difficult to put over a telling point, with basic engineering correctness and without delving too deeply into abstruse technicalities.

Objectionable because of its futility is the attempt to dress up a product with technical virtues or characteristics in its design and manufacture, that it does not possess. Cotton-reels and nuclear reactors are both useful, and their precision manufacture is an art; but it will be conceded that the copywriter has much more material to exploit in the case of the latter. Platitudes stressing the obvious, again, lessen the reader's respect for the advertiser. Examples of these are that toothed gearing does not slip; that ball bearings have little friction; or that oil firing eliminates coal bunkers. An allied objection is the ever-present gratuitous addition to a photograph—"cover has been removed to show interior."

The practice of comparing a competitive product unfavourably with one's own, by swinging the vices and virtues in the appropriate directions, is basically unsound, even when the vices are, as usually, by implication. The maintenance engineer in the advertisement, blaspheming over his halt and lame machine, may bewail "Why didn't I fit——"; but the reader who has a room full of trouble-free duplicates, all equipped with the rival material, is not likely to think as the advertiser intended.

Advertising is a profession in its own right; but whereas few people would presume to suggest to a surgeon or ship's captain how to conduct his business, it is not unusual to find factory executives with a secret conviction that they are advertising experts. Consequently, however well reasoned and excellently contrived an advertisement may be, it is apt in such circumstances to suffer several sea-changes before it reaches the press, and truth is sometimes a casualty. The advertising chief finds himself pushed, pulled and persuaded in all directions by importunate beings, every one of whom seems to him to have completely missed the basic theme that "started the thing off."

TECHNICAL ADVISER

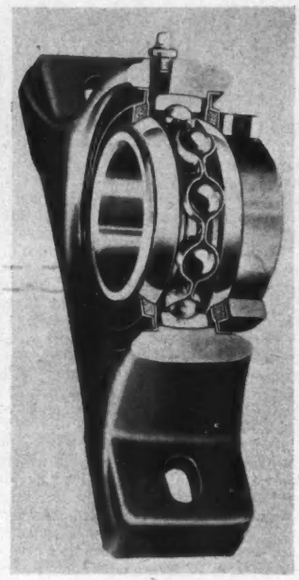
To ensure technical accuracy and integrity, as well as helping to resist these and other pressures, the presence on the advertising staff of a competent technical adviser is essential in any organization that maintains a comprehensive publicity department. The established technical set-up of design and drawing offices, etc., is almost invariably too preoccupied with the facts of life, as they relate to the design, manufacture, and usage of the products, to be able easily to switch to the more abstract philosophy necessary in getting the story across to outsiders. Thus, submission of drafts and proofs to individual specialist engineers in these departments is rarely satisfactory.

The publicity advisory engineer, on the other hand, must for complete success be a rather unusual type, inquisitive to know how things work, and unsatisfied if faced with an unfamiliar mechanism until he has probed its secrets. Only in this way will a high degree of accuracy be obtained when a large variety of machinery is being dealt with, since he will ensure not only that illustrations and references are kept up to date, but that the descriptive matter accompanying them is sensible and correct in emphasizing the significant features. Ideally, he should also have the appropriate status to ensure that in matters such as have been outlined, his opinion on technical points is final.

To those who may consider that this article has made rather heavy weather of what is on the face of it a fairly straightforward task, its objects can be stated simply. Firstly, to show that for the large sums now spent on advertising, a high standard should be insisted upon, and is by no means difficult to obtain by adequate organization. Secondly, that while an accurate and mature approach to the reader can hardly fail to react favourably, its converse may well have an effect the extent of which, because of its subtelty, cannot be gauged.

BALL BEARING PILLOW BLOCKS

Heavy Duty



RECENTLY announced is the P2-300 series of heavy duty ball bearing pillow blocks, for which advantages of heavier housing and dimensional interchangeability are claimed.

These blocks are equipped with self-aligning, single row, deep-groove precision ball bearings which conform to basic standards of the AFBMA (Anti-Friction Bearing Manufacturers' Association). A complete range of shaft sizes from $\frac{1}{2}$ in to 4 in is available.

Lubrication fittings incorporate a pressure-release feature; bearings are supplied factory lubricated, sealed, and ready for use. The lubricant passes freely between the seal and outer ring into a large reservoir.

A 4-page folder, No. 2951, "Series P2-300 Self-Aligning Ball Bearing Pillow Blocks," contains additional information on these new bearings, which are available in 31 shaft diameters, and a full page chart shows interchangeability dimensions. *Link-Belt Company, Prudential Plaza, Chicago 1, Illinois.*

MAGNETIC PICK-UPS

Experimental Assortment

ANNOUNCED by Electro Products Laboratories, Chicago, Illinois, is a magnetic pick-up experimental assortment which offers facilities for the low cost solution of problems in instrumentation.

This set is complete with sub-miniature, miniature, standard output and high output pick-ups, in a plastic box with detailed operating and application data, speed measurement and control problems.

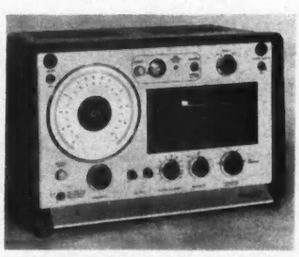
Electro magnetic pick-ups are self-generating input transducers providing the connecting link between mechanical motion and instrumentation. They generate voltage and power without the aid of power supplies.

Voltage/frequency generated by these compact and sensitive transducers, from mechanical motion (without contact), is in proportion to the speed of metal objects interrupting their magnetic fields. The external magnetic field created, when interrupted by a metal projection, generates an ac voltage which leads to the resolution of many speed measurement and control problems.

These mechanical electrical converters may be used to indicate motion, rpm, sequences, torque, angular position, linear position, speed variations, vibrations and operating cycles. Other uses are in the actuation of electronic counters, recorders, servo-mechanisms and tachometers; the synchronization of oscilloscopes, the control of magnetic amplifiers, relays, solid state switching and Thyratron circuits. *Sylvan Ginsbury Limited, 8 West 40th Street, New York 18, NY.*

VLF FUNCTION GENERATOR

For Complex Waveforms



SHOWN here is the VLF function generator SG88, claimed virtually to eliminate the difficulties normally encountered in the generation of unusual waveforms. Simulation of heating and cooling cycles in nuclear power stations and the analysis of servo-systems are some of its applications.

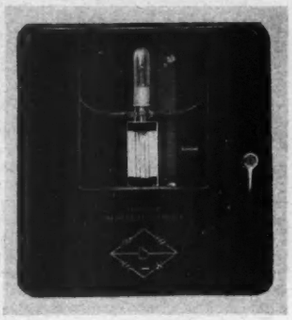
This instrument is basically an optical/mechanical system; the conventional oscillator circuit is replaced by interchangeable transparent rotating discs, scanned by a narrow light beam. Printed on each disc is an opaque pattern representing in polar coordinates the wave-shape or function to be produced. The range of wave-shape is virtually limitless, requiring only that the function from which each is derived is single-valued and repetitive.

The output frequency is continuously variable from 0·005 c/s up to a nominal maximum of 50 c/s. By increasing the number of complete patterns on the disc, the upper frequency limit can be increased to several times the nominal value. Acceleration of the disc on the two lower frequency ranges permits an almost instantaneous start from any predetermined point of the waveform. Sweep facilities are provided on the two upper frequency ranges.

The distributed frequency spectrum of the SG88 when generating noise provides a particularly suitable method of vibration study and fatigue testing. Output voltage is 200μV to 20V, peak-to-peak, high impedance; output waveforms can represent any single-valued repetitive function. Angular resolution of the optical system is 0·5°, and the frequency response of the whole system is 0 to 3 kc/s. *Advance Components Limited, Hainault, Essex.*

MAGNETIC OXYGEN METERS

Rapid Response



THESE oxygen meters have been developed for the determination of oxygen concentrations using methods based on the high paramagnetic susceptibility of the gas. They have a wide range of industrial applications, especially in the measurement of oxygen in boiler and cement flue gases.

The fact that all other common industrial gases, with the exception of nitric oxide, are diamagnetic, enables accurate oxygen analysis to be carried out by the application of magnetic principles.

Two types of instrument are available, the Filament type and the Annulus type. These two versions are similar in external appearance, but incorporate different interchangeable analyser units.

The manufacturers recommend the Annulus type as being particularly suitable for those oxygen estimations where more than 1 per cent of hydrogen or helium is present, or for those applications where a higher speed of response is desirable. This type is, however, affected by carbon dioxide and must be kept in a level position when used.

Conversely, the Filament type detector is comparatively insensitive to carbon dioxide and is more suited to conditions associated with change of level.

Minimum ranges are given as 0 to 8 per cent or 0 to 2 per cent oxygen, full-scale reading, these being dependent on the type of indicator or recorder used in conjunction with the instrument. *Cambridge Instrument Company Limited, 13 Grosvenor Place, London SW1.*

MOULDING MACHINE

For Polyester Dough

THE new SPA injection moulding machine illustrated here is capable of forming polyester dough compound for engineering components.

This mass production process unit, manufactured by Maschinenfabrik Georg Seidl K.G. of Munich, can be used appropriately with Rockite Dough Moulding Compound, a material which is supplied by British Resin Products Limited.

The SPA machine has two injection cylinders which are loaded individually and then placed in the machine. Each filled cylinder is then rotated to feed up to 6 different moulds on a revolving table.

Moulds of different filling volumes can be used on the same table, so that it is possible to produce strong and accurate mouldings from 20 to 500 gm as the table revolves.

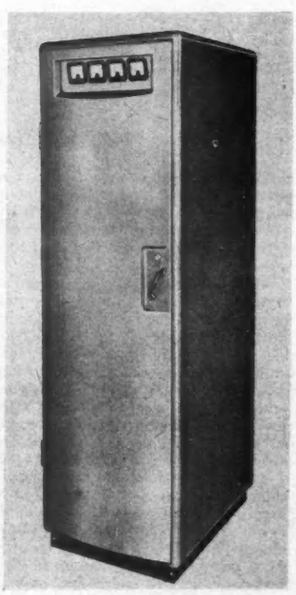
Dough Moulding Compound is a fibre reinforced polyester moulding material which has hitherto been restricted to the compression moulding field. Injection mouldings in Rockite DMC produced on the SPA machine are said to possess the characteristics of high strength, good finish and good mouldability of material which has been moulded by compression.

The new machine is expected to make a significant contribution to the extension of the use of this type of moulding compound in the electrical and light engineering industries.

The SPA unit, which is available in varying table sizes, is also suitable for the injection moulding of natural and synthetic rubber compounds. *C. and A. Simms (Engineers) Limited, Maidstone, Kent.*

TRANSMITTING AMPLIFIER

For Telecommunications



THIS 1 kW RF linear transmitting amplifier has been designed for aeronautical, marine and civil administration fixed services.

Meeting the general requirements of ICAO, DEF 5000 and ISTC specifications, it is suitable for operation between − 15° C and + 55° C within the frequency range 1·6 Mc/s to 27·5 Mc/s. A power output of 1 kW peak envelope power (p.e.p) can be delivered.

The amplifier consists of an RF unit, a power unit and a control unit. The frequency range covers continuous tuning from 1·6 to 27·5 Mc/s, and bandwidth is 12 kc/s. Output power is given as not less than 1 kW mean under CW conditions, and not less than 1 kW p.e.p. under multi-tone conditions, output impedance being 50 ohms, unbalanced. Input power is adjustable from 75 MW to 500 MW into 75 ohms (nominal). Power supply required is at 100-120 V, 200-250 V, 40-60 c/s single phase. Power consumption is approximately 5 kVA. *Plessey Company Limited, Ilford, Essex.*

TOROIDAL ARC WELDER

Strong Construction

A NEW version of the Fararc toroidal arc welder, the Series III, has recently been introduced and incorporates features of robustness of particular appeal for site and maintenance welding.

Grain orientated silicon steel is used for the transformer core and the windings are of double glass covered copper; the insulation uses asbestos and glass cloth, and the whole transformer has a triple vacuum impregnation process with silicone varnish. It is fan cooled, and a thermostatic control cuts off the welding current in the event of overheating, but leaves the fan running. The thermostat brings in the main current again, after rapid cooling of the set, at the correct temperature.

The unit has a current range from 60 to 300A with a continuous rating of 200A. Power factor varies between 0·8 and 0·9, and magnetizing current is 80 milliamps. The unit weighs only 90 lb and is contained in an all steel case measuring 14 in cube. A primary entry at the back

measuring 6 in by 4 in allows easy change of copper bus-bars to give 200/250V or 400/440V running. *Portable Welders Limited, Castle Mills, Buckingham.*

CRAWLER TRACTOR

Improved Model

THE FIAT 70 CI tractor is a general-purpose tracked machine intended both for industrial and agricultural application. It is a direct descendant of the 60 CI model with certain important improvements.

At 13,000 lb operating weight, it is 500 lb heavier than its predecessor. An increase of length of track on the ground and slightly greater width give low ground pressure and good stability. The grouser height has been increased to 1 1/8 in to secure maximum traction.

The diesel engine is a 4-cylinder four-stroke direct injection type developing 70 bhp at 1,400 rpm. Bore and stroke are 125 by 140 mm and compression ratio is 15·5 to 1. A dynamic balancer has been incorporated for smoother running. The main clutch is of the dry single plate type.

Full pressure lubrication is supplied by a dual pump in the sump, operating at 36 to 43 lb per sq. in. Cleanliness of the oil is ensured by a screen type filter in the sump, a self-cleaning fin type filter in the

delivery pipes, and a replaceable cartridge by-pass filter.

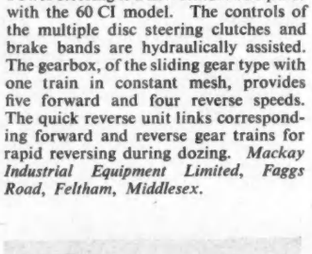
Two methods of starting are offered: by a two-cylinder horizontally opposed 10·5 hp engine or a 24 V starter motor. Power steering is a new feature compared with the 60 CI model. The controls of the multiple disc steering clutches and brake bands are hydraulically assisted. The gearbox, of the sliding gear type with one train in constant mesh, provides five forward and four reverse speeds. The quick reverse unit links corresponding forward and reverse gear trains for rapid reversing during dozing. *Mackay Industrial Equipment Limited, Faggs Road, Feltham, Middlesex.*

AC VOLTAGE STABILIZER

Automatic

THIS lightweight ac stabilizer, the type TS-1, provides rapid, accurate and distortion-free stabilization over an input voltage range of 25 per cent, with an output of approximately 1 kVA. It will be of interest for use with measurement, telecommunications and control equipment.

Alternative connection gives approximately 2 kVA output with 12½ per cent input range. The unit is sufficiently small and inexpensive to be used with individual pieces of equipment, and in-built if required. The solid-state control circuit has no valves or relays and produces no radio interference. The unit has a high response speed of 40 volts per second, and no waveform distortion. An accuracy better than ± 0·5 per cent from zero to full load is claimed, and the unit is unaffected by supply frequency variations or by load power factor. The standard version is indoor tropical rated and operates up to 45° C without derating, and up to 65° C with derating. Six alternative combina-



tions of output current and voltage correction range are possible.

The stabilizer comprises a motor-driven "Variac" variable transformer, controlling the primary of an auxiliary "buck-and-boost" transformer, the secondary of which is connected in series with the supply, so as to inject a variable aiding or opposing voltage to correct for any error. The "Variac" is automatically positioned by a transistorized sensor unit, to maintain the output voltage at the required value. The output voltage setting may be any value between 200 and 254 volts. *Claude Lyons Limited, Valley Works, Ware Road, Hoddesdon, Hertfordshire.*

MULTI-PURPOSE RADIO RECEIVER

Superheterodyne

THIS newly-designed five band receiver kit employs a sensitive, selective superheterodyne circuit to receive international shortwave stations, ships at sea, aircraft, time signals and amateur transmissions, in addition to standard AM broadcasts.

The coverage of this unit, which is known as the Knight-Kit R-55, extends from 530 kc to 36 mc in four bands, plus a special range from 47 to 54 mc for tuning the 6 metre amateur band.

The kit is supplied complete with metal cabinet, tubes, all parts, wire and solder. Point-to-point wiring throughout, with large-sized picture diagrams and detailed instructions, facilitate the assembly of the unit.

It is claimed that the 1,650 kc intermediate frequency and two IF stages provide image-ratio and sensitivity figures of exceptional quality for receivers of such low cost. A fused, transformer-type power supply with filter choke is designed for efficient use of all amateur bands from 80 to 6 metres; this makes

the reception of crowded signals easier than would otherwise be possible.

Other features include: modular coil assemblies; adjustable BFO; automatic volume control; noise limiter; flywheel-loaded tuning dials; and edge-lit scales calibrated in megacycles.

The unit also has a built-in PM speaker for clear reception and a headphone jack for private listening. A crystal calibrator kit, which is helpful in marking amateur band edges and in locating foreign shortwave stations, is available to provide an accessory which may be built into the receiver chassis itself. *Ad Auriema-Europe, SA, 172A Rue Brogniez, Brussels 7, Belgium.*

POWERED BAR BENDER

Multiple Bending

THIS semi-automatic machine, a new addition to the "Staffa" range, has been designed to bend black mild steel bars up to 1½ in capacity and similar sections cold, while arrangements can be made for multiple bending of smaller sections.

The frame is of steel construction and all gearing is machine cut. Ball races are used in all bearing houses, with the exception of the main spindle which has heavy bronze bushes.

The working surfaces are machined and ample provision is made for lubrication. A three-way control handle gives forward, neutral and reverse positions and the rotating roller attached to the plate is controlled for angle of bend by a movable pin.

For maximum bending speed, three pulleys are fitted in an accessible guarded position. An adjustable plate provides reaction close to the point of bend, thus ensuring a consistent radius throughout. Power is supplied by a 3 hp drip-proof motor on an adjustable tensioning

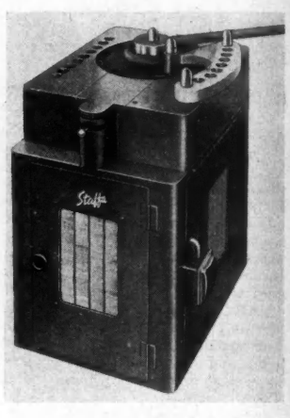


table. An isolator switch is fitted; power requirements are 440 V, 3-phase, 50 c/s ac. Interchangeable steel formers equal to 4 × D are incorporated to bend reinforced concrete bars from ¾ in to 1½ in diameter to standard radii. *Chamberlain Industries Limited, Staffa Works, Argall Avenue, London E10.*

GUNMETAL STOP VALVES

Gas and Hydraulic

DESIGNED for use in either pneumatic or hydraulic circuits, or with non-corrosive gases, Simplifix type 60 valves are now available in ¼ in, ½ in, ¾ in and 1 in BSP (female) sizes.

All these valves are manufactured in gunmetal, which offers a high resistance to corrosion. The spindles are made from manganese bronze and have a fine thread which facilitates opening and closing. The spindle seal is inside the thread and therefore the medium in the valve does not come into contact with the thread area at all. The valve tip is of nylon.

The port connections on these valves are suitable for Simplifix stud couplings, which thus combine to accommodate a large range of pipe sizes. Maximum working pressures (lb per sq. in) for hydraulic and gas applications respectively are: for ¼ in in-line: 1,000 and 200; for ½ in in-line: 600 and 150; for ¾ in off-set: 400 and 100; and for 1 in off-set: 250 and 100.

All valves are individually tested to one and a half times working pressure

before leaving the works; they are not suitable for use with steam. *Simplifix Couplings Limited, Hargrave Road, Maidenhead, Berkshire.*

PORTABLE TELEPHONE

Compact and Cheap

KNOWN as the Stanophone, this portable telephone provides rapid and cheap links between two or more points.

The system offers a wide variety of uses in industry, agriculture and commerce: this illustration shows part of a permanent installation in the Scottish Gas Board's Lurgi gasification plant at Westfield, Fife.

This telephone combines all its necessary equipment, including batteries, inside a lightweight handset which gives clear speech over distances up to 20 miles using only a pair of wires or even a single wire and earth.

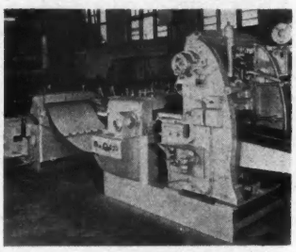
The handset, made from durable plastics, also contains the buzzer and transformer units. The instrument is simple to connect, the only necessary preparations being to bare the ends of the communicating wire, to press down the two spring terminals, push each wire into a terminal hole and release.

Pressing the red button on the handset originates the calling signal, which takes the form of an inductive "howl" in the earpiece. This signal is also heard in the calling instrument, thus providing a check that the line is in order and that the call has actually reached the other end of the line. The black button is used for speech.

The batteries may be replaced by loosening the two cover screws and removing the back of the handset: three small torch-type batteries are then inserted. Suitable batteries are Ever Ready U11, Drydex T 15, Vidor VOO 11 and Siemens T 12. The weight of the instrument complete with batteries is 19 oz. *Standard Telephones and Cables Limited, Industrial Supplies Division, Footscray, Kent.*

METERING DEVICE

For Coil Cut-Up Lines



COIL cut-up lines made by Press Equipment Limited are now available with a new electro-mechanical metering and measuring device which is claimed to have advantages over the conventional end stop and retracting run-out track.

End stop systems have limitations where it is required to cut long lengths, and particularly where there is a wide range in width of strip. Again, the space occupied by the track and mechanism at the rear is often a drawback.

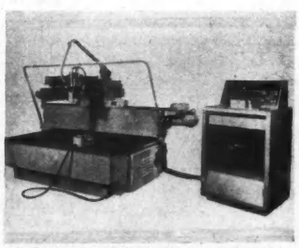
The device operates in conjunction with the straightening unit of the line, detects the amount of material passing through the outgoing pinch rolls, and automatically stops the straightener and operates the shear when it has metered off the required length. It incorporates automatic re-set to provide instantaneous re-start of the straightener.

Setting of length required is by two dials, one for feet and the other for inches, the former requiring only a coarse setting. Accuracy on lengths up to 12 in is of the order of $\pm$ 0·015 in and, unlike end stop arrangements, it is said not to deteriorate on longer lengths.

The illustration shows this device fitted to a 36 in wide by 0·048 in coil cut-up line, with decoiling unit incorporating power driven pinch rolls to draw the material off a mandrel mounted between roller bearings, the speed of the pinch rolls being automatically governed by a Heenatron variable speed drive controlled from a catenary detector between the decoiler and straightener. The line is capable of handling aluminium strip down to 0·007 in thick. *Press Equipment Limited, Hunters Vale, Birmingham 19.*

INSPECTING MACHINE

For Aircraft Components



DESIGNATED Model AM7236, the HPE-Ferranti universal automatic measuring machine which is illustrated here has been designed in response to the increasing requirements of the aircraft industry for the rapid and close-tolerance inspection of large components.

The unit has been designed by High Precision Equipment Limited in co-operation with Ferranti Limited, and is reported to be capable of carrying out the inspection of many different types of components, some examples of which are given as large template shapes, three-dimensional forms, including aerofoils and wind tunnel models, and large castings within an overall capacity of 72 in by 36 in by 24 in.

The machine has been constructed with the numerical positioning control equipment on the horizontal axes of measurement, together with a specially designed measuring system in the "Z" or vertical axis, this being intended for the measurement of a displacement which may arise from a horizontal datum.

A continuous display of position on all three axes has been provided for, and a variety of further facilities is incorporated, these covering paper tape or manual decade dial information input as well as overall manual control of all slide movement.

In addition, the machine is provided with facilities which enable output signals for the operation of print-out or Hollerith punched-card equipment to be given. An accuracy of readings to within 0·00025 in is claimed for the machine by the manufacturers. *High Precision Equipment Limited, Bletchley, Buckinghamshire.*

DIFFERENTIAL PRESSURE GAUGE

With Magnetic Coupling

A DIFFERENTIAL pressure gauge, with an indicating range from zero to 60 lb per sq. in and a 3,000 lb per sq. in working pressure rating, has now been introduced, and has applications in the ground support, process and manufacturing fields.

The new gauge is designed for use with hydraulic oils, including MIL-H-5606, and phosphate esters, lubricating oils and fuels.

It gives a direct reading of tank levels, as well as of pressure drops across filters, heat exchangers, orifices for flow metering, gas adsorbers and other similar types of equipment.

In common with the pressure switches and indicators in the manufacturers' Deltadyne series, these units have no mechanical linkages; their operating principle is based on a magnetic coupling, a constructional technique which is intended to eliminate the possibility of leakage.

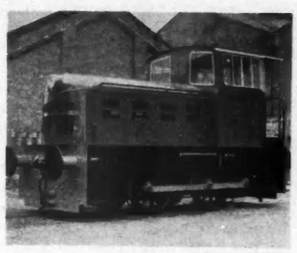
Mounting is by line with ¼ in NPT or AND10050-4 connections, or alternatively the gauge may be mounted by means of a sub-plate.

The standard materials of construction employed are aluminium and nickel alloys, but other types of material are available for special requirements.

The gauge is reported to have an accuracy of $\pm$ 2 per cent and is designed to function over a temperature range extending from $-$ 40° F to $+$ 200° F. *Pall Corporation, 30 Sea Cliff Avenue, Glen Cove, New York.*

DIESEL SHUNTING LOCOMOTIVE

Industrial Model



THE latest addition to the Fowler range of industrial diesel shunting locomotives is a hydraulic unit embodying a British Twin-Disc 10,000 series three-stage torque converter.

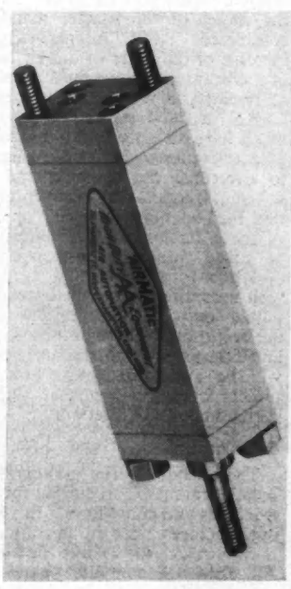
This locomotive is available for gauges from 1 metre to 5 ft 6 in (1,676 mm), the weight in working order being 28 tons in the 0-4-0 model and 30 tons with an 0-6-0 wheel arrangement. The BUT/Leyland UE902 diesel engine is rated to develop 203 bhp at 1,800 rpm (12 hour continuous rating), and is a 6-cylinder, 4-stroke, water-cooled, naturally aspirated unit.

An over-centre clutch between the engine and torque converter enables the drive to be disconnected from the rail wheels for starting and direction changing, and is operated by an air cylinder controlled automatically in conjunction with the direction control system. From the torque converter the drive is taken through Layrub couplings and cardan shaft to a "Wiseman" 15RLGB reversing and final drive unit which is bolted to the main frame.

Maximum starting tractive effort is 18,000 lb, top rail speed when running light is 15 mph, and in the event of overheating of either cooling water or transmission fluid the engine is automatically shut down. The cab allows good all-round vision and is provided with heater, front and rear windscreen wipers and tool lockers. A console carries duplicated controls at either side of the cab, instruments being arranged on a panel in the console centre. Main controls comprise throttle, Westinghouse air brake and direction levers. *John Fowler (Leeds) Limited, Hunslet, Leeds 10, Yorkshire.*

AIR CYLINDER

Small Size



RECENTLY introduced is the unusually small-sized air cylinder which is shown here; this has potential applications in many cases where space is at a premium.

Believed by the manufacturers to be the smallest air cylinder of British design available, the unit is of ½ in bore diameter and is double-acting. It is produced in three standard lengths of stroke from ½ in to 1½ in.

The construction of the cylinder allows for rear manifold mounting, a factor which makes it particularly suitable for fitting in confined spaces where there would be no available room for the accommodation of pipework to the ports.

The body of the unit is of brass, the rod being manufactured from stainless steel. Synthetic rubber distributor-type U seals are provided on the piston, and a rod seal of similar construction is fitted in the body. *Air Automation, 26 Sharrocks Street, Wolverhampton, Staffordshire.*

High Energy Results

LAST year was noteworthy for CERN with the successful operation of the 600 MeV synchro-cyclotron and the 28 GeV proton synchrotron; the latter came into operation at the end of 1959 and was inaugurated in February of last year. The present mean beam intensity of 10^{11} protons per second is the highest of any proton synchrotron yet built and the maximum energy of 25-28 GeV can only be exceeded by the 30 GeV AGS machine at Brookhaven which came into operation in the autumn of last year. J. B. Adams, director general, says in the annual report that although CERN is now reaping the rewards from the planning of ten years ago making the laboratory one of the foremost of its type in the world, it is necessary for the organization to look forward now to the 1970's.

Protron Synchrotron

A steady improvement in beam intensity was achieved starting with $2 \cdot 10^{11}$ protons per pulse and increasing to $3 \cdot 10^{11}$ protons per pulse. Although the experimental time was limited, the development of target techniques enabled more than one experiment to run simultaneously, thereby increasing the effective experimental time. Targets giving short bursts of secondary particles of 200 to 300 micro-seconds duration and low intensity for bubble chamber experiments could be used at the same time as other targets giving long bursts of high intensity up to 400 milli-seconds for counter experiments. With the completion of other experimental areas during the next two years, it will be possible to increase the sharing of the accelerated beam even more. Over 200,000 bubble chamber photographs were taken in 1960 in the high energy pion and proton beams of the proton synchrotron using two chambers, the 30 cm CERN hydrogen bubble chamber and the 1 m Ecole Polytechnique propane bubble chamber. It is later hoped to replace the CERN chamber by the 80 cm CEA hydrogen bubble chamber and a 1·5 m hydrogen chamber from the United Kingdom.

New Destiny for the Synchro-cyclotron?

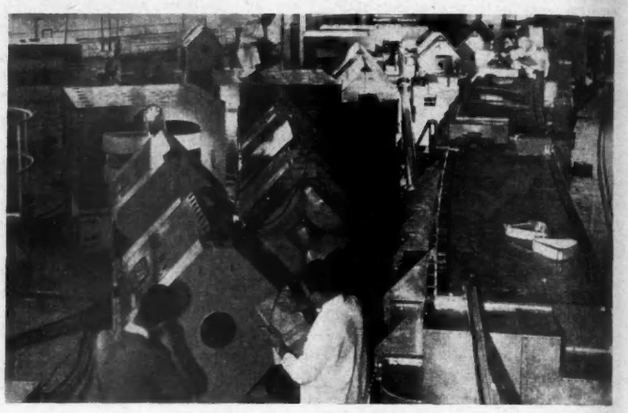
The synchro-cyclotron has proved a very useful training ground for the training of experimental teams, which during last year carried out the exploratory nuclear physics work on the proton synchrotron; the second purpose of the machine was to carry out fundamental research in pion and muon physics. Since there are many synchro-cyclotrons in the world, and now that physicists can join experienced teams on the larger machine, the future of the smaller machine should be considered. Mr. Adams suggests that an increase of the order of one or two magnitudes in the beam intensity would open up a new field of research in pion and muon physics and put CERN in the forefront of this field. Experiments have been made with the stochastic method of acceleration using non-coherent acceleration to overcome the space charge limitations in coherent acceleration near injection: however, this method only doubled the beam intensity. A more fundamental modification that could be made would be to convert the synchro-cyclotron to a spiral ridge cyclotron operating with a continuous output instead of the present pulsed output. Modifications on this aspect are being studied both inside and outside CERN, and if the proposition appears feasible the Council will be approached next year, although the present budget will not be sufficient to cover such a major modification.

Data Analysis

The analysis of the photographs taken using bubble chambers requires further specialised machines and computers. In 1960 three analysing machines were in operation and the data for these machines fed into the Mercury computer. An IBM 709 computer and seven analysing machines are now being installed. To assist with the large number of photographs, other laboratories with similar facilities will investigate some of the material.

Other Activities

Many exploratory experiments and preparatory experiments have been made in preparation for more comprehensive ones using techniques other than bubble chambers, counter experiments and emulsion experiments. For example, it has been found that high energy deuterons, tritons and He^3 nuclei are present in the secondary beams of the proton synchrotron, and there is an abundance of antiprotons and K-particles in the secondary beams from integral targets. At the end of last year it was also decided to set up an experiment to investigate whether there are two types of neutrinos.



View of the proton synchrotron target area showing the outgoing secondary beams. Particles are focused by quadruple lenses and analysed by bending magnets.

Looking to the Future

In addition to the modifications to the synchro-cyclotron, a group is investigating the possibility of building an electron model of a storage ring system which could be applied to the proton synchrotron. Although the project would cost twice that of the proton synchrotron, it would allow experiments to be done with energies in the centre of a mass system of 50 GeV or 1,250 GeV in the laboratory system. It is also proposed that a study group is set up, in conjunction with the United States and Russia, to investigate accelerators with energies in the 500-1,000 GeV range.

Lattice Calculation Errors

Serious errors in fine structure calculations may arise through the use of the cylindrical cell approximation together with the transport methods. The effect of this approximation is to overestimate the ratio of the flux in the moderator to the flux in the fuel. In a report "Errors due to the Cylindrical Cell approximation in Lattice Calculations," by D. A. Newmarch (AEEW-R34) it is shown that the use of the cylindrical cell approximation gives a flux in the moderator which is considerably higher than in the fuel, even when the cell dimensions in units of mean free path tend to zero. In the case of real cells the flux ratio must tend to unity. It is also shown that for cylindrical cells of any size the ratio of the flux in the moderator to fuel flux tends to infinity as the moderator neutron cross-section tends to zero.

Sufficient Commercial Investment in Cobalt 60

The United States Atomic Energy Commission is withdrawing from the routine production and distribution of Cobalt 60, since sufficient quantity is now being produced in the test reactors of the Westinghouse Electric Corporation and General Electric Company. However, to encourage the development of ionizing radiation as a major processing tool the USAEC will continue to provide cobalt 60 up to a specific activity of 30 curies per gram in quantities greater than 100,000 curies. The charges for the varying specific activities are given below:

Specific activity (curies per gram)	*List price per curie*
1–25	$2·00
26–40	$3·00
41–55	$4·00
56–70	$6·00

Discounts

0–5,000 curies	List price
5,001–25,000 curies	List price less 15 per cent
25,001–100,000 curies	List price less 30 per cent

Reactor Notes

Air lift of Nuclear Power Plant: The transportation of the PM-1 reactor to be constructed at Warren Peak, Wyoming, by the Martin Company, Baltimore has begun. The plant has been delivered in 16 packages. The pressurized reactor will be cooled and moderated by light water and will be fuelled with highly enriched uranium, which will provide 1MW of electrical power and 2MW of heat for the radar station of the Defence Command. The plant is scheduled go be critical next month and will be operational in 1962. The operating crew includes 17 airmen under the supervision of an Air Force Officer.

United States–Japan Agreement: The United States have signed an agreement with Japan for the leasing of nuclear materials to be used in fuelling the Japanese research and material testing reactors. The new agreement is designed to simplify the leasing of small quantities of special nuclear materials needed by Japan for its reactors, and replaces three earlier agreements.

United States Grant: The United States has granted $80,000 worth of nuclear equipment to assist the development of the peaceful uses of atomic energy in Argentina, Brazil and Israel through the Agency's technical assistance programme. Argentina will receive a mass spectrometer ion source and an electron paramagnetic resonance spectrometer; Brazil will have equipment for research in the use of isotopes for agriculture; and Israel equipment for one mobile and two stationary monitoring stations for use at Reheveth, where a swimming pool research reactor is being built.

High Flux Reactor: The National Bureau of Standards at Gaithersburg, Maryland, are to have a 25 MW reactor which will provide an in-pile flux of 10^{14} neutrons per sq. cm per second. It will use enriched uranium fuel with aluminium cladding and heavy water moderation, and will be similar to the CP5 research reactor at the Argonne National Laboratory.

Companies

Looking Towards the Future

In his recent survey of trading conditions, Sir Charles Westlake, M.I.E.E., chairman of Metal Industries Limited, comments that the past year has not been an easy one and that the coming months will be a challenge to production efficiency.

The factor that disturbs the whole of the engineering industry, he states, is the steady rise in production costs, particularly in relation to wages and salaries. Metal Industries have estimated that the recent engineering award will add at least £250,000 to their wage bill in the current year. In addition, the award may well be reflected in the prices which the organization will have to pay for materials and part-manufactured goods.

In these conditions, the engineering industry must, above all, seek the improvement of management at every level, scrutinize afresh methods of production and maintain a rigid control of expenditure so as to eliminate waste; materials, time and human effort alike. The whole of our thinking must be concentrated on, and the whole of our endeavour geared to, the need for manufacturing more efficiently and more cheaply.

Metal Industries Largely Electrical

Trading profits of Metal Industries, before tax, for the year ended 31 March, 1961, exceeded £2,436,000. At a time when engineering profits almost everywhere were more difficult to obtain, Sir Charles considers, very reasonably, that his shareholders will agree that this is a not unsatisfactory figure. The profit level is, in fact, very close to the forecast which he made more than twelve months ago.

Brookhirst Igranic Limited, the group's major electrical subsidiary, and Towler Brothers, which are exploring promising new fields in hydraulics, both had an excellent year. Their profits exceeded expectations and went some way to make up for the more adverse trading conditions in the scrap-metal market and for difficulties, now being resolved, in the administration of the organization's mechanical engineering subsidiary, Fawcett Preston.

The trading profits of the former Lancashire Dynamo companies for the 15 months ended 31 March last totalled £872,000, compared with £863,000 for the twelve months ended 31 December, 1959.

Sir Charles states that the integration of these newer companies with the older members of the group has been, as was known that it would be, a complex and slow process: complex because of the necessary reorganization that had to be undertaken in some of the units; slow because problems involving human relations must be resolved with care in order to produce lasting results.

Even before the merger with the Lancashire Dynamo companies, Metal Industries' electrical interests were responsible for over 55 per cent of their profits and the proportion is now approaching 75 per cent. The original interests of the group, metals and shipbreaking, now account for less than 10 per cent of the profits.

Who Owns What?

An illuminating analysis of their various types of shareholders is contained in the current accounts of Metal Industries. The group's ordinary share capital increased from £2,496,000 in 1951 to £7,505,000 last March. During the same ten years the number of shareholders more than doubled, rising from 4,249 in 1951 to 9,824 in 1961.

Institutional investors now number 799 against 251 in 1951, and include 76 insurance companies, 135 investment trust companies, 49 pension trusts, and 426 banks and nominee companies. There are also 89 other limited companies and 24 charitable bodies of one sort and another. Together, these institutional investors own 56·8 per cent of the stock.

The remaining 43·2 per cent of the group's ordinary stock is now held by 9,025 individual shareholders, compared with a total of 3,998 ten years ago. Now, 7,742 persons own from £1 to 500 each; 918 own from £501 to 1,000 each; 346 own from £1,001 to 5,000 each; while the remaining 19 own more than £5,000 each.

On a sex basis, individual shareholders are almost equally divided, there being 4,657 men and 4,368 women and they own, respectively, 24·7 per cent and 18·5 per cent of the shares.

Paying Throughout a Machine's Life

An interesting development in hire-purchasing arrangements was introduced by United Dominions Trust Limited a short time ago through the medium of their subsidiary concern Engineering Finance Limited.

Normally, the maximum periods of hire-purchase agreements are much shorter than the lifetimes of many of the larger units of plant and mechanical equipment and, for such items, the firm have devised a means of providing secured finance over periods more in line with their machine lives. Since the details of the scheme were announced there has been a widespread response from industry.

It is now reported that although, in most cases, early delivery of the plant is either not required or not possible, Engineering Finance have already achieved a sizeable volume of business for customers of undoubted worth and they are now busy with the investigation and acceptance of future business for a number of other concerns.

Industry generally seems likely to continue its welcome to this arrangement and the firm may well be making a substantial contribution in an extended field of industrial finance.

No small part of the attraction of the scheme appears to be the simplicity of the procedure.

Highlights in Instrumentation

Great strides forward are being made by British instrument makers, both in the research field and in the development of new ideas and techniques in equipment.

Among firms in this category are the Marconi group of companies and a selection of their apparatus is being shown in the static exhibition at the Farnborough flying display of the Society of British Aircraft Constructors on 4 to 10 September, when Marconi's Wireless Telegraph Company Limited and their associates, Amalgamated Wireless (Australasia) Limited, the Canadian Marconi Company and Marconi Instruments Limited, are exhibiting on adjoining stands.

Their displays are aimed at giving a foretaste of what instruments are coming along in the future as well as attracting the interest of prospective buyers of new production equipment. In this connection, the firm's Sixty series of airborne radio equipments and navigational aids scored an outstanding success on its introduction at last year's display and has already resulted in business running well into six figures.

Representing the near future at next September's air show will be what is believed to be a " world first " in radar display units: a compact equipment which will provide, for the first time, both radar and synthetic display facilities on a single Plan Position Indicator tube. Many new techniques have been incorporated to achieve this result. The delivery date for this apparatus is 1963.

Another exhibit, shown in the accompanying illustration, will incorporate their tabular display unit SD1016 and the combined radar/synthetic display unit SD1015. The latter provides the operator with a radar picture containing additional synthetically-produced identification symbols. Range rings, video map and azimuth marks can be selected in the single display.

The SD1016 unit is designed for use in data-processing systems and can provide instantaneous flight information for air traffic controllers in simple tabular form.

Marconi tabular and radar/synthetic display units. The closed-circuit television screen on the left is being used here to give an advanced display of meteorological information. The tabular unit is for use in data-processing systems.

Vokes Extend Their Interests

Among United Kingdom firms engaged in widening their production are Vokes Limited, designers and manufacturers of an extensive range of filtration equipment. The firm are now entering the UK and European market as suppliers of separating machinery.

Under licence from the Chain Belt Company, Milwaukee, USA, the company are manufacturing the complete range of Rex process plant. These will include such items as mechanically-cleaned bar screens, grit collectors and washers, circular and conveyor-type sludge collectors, skimming pipes, disintegrators and flocculation apparatus.

The firm are exhibiting at the Second Effluent and Water Treatment Exhibition at Seymour Hall, London, W1, at the end of October, when examples of these products will be displayed.

Butterfield's New Acquisitions

In accordance with the company's policy announced about a year ago, W. P. Butterfield Limited, Shipley, Yorkshire, acquired Swintex Limited, Bury, with effect from 1 October last. Swintex manufacture rubber and plastics mouldings and Butterfield have thus taken steps to ensure, among other things, that there shall be a continuous supply of rubber lids for the large numbers of dust bins produced at both Shipley and Bilston. They have also improved their ability to expand in the plastics field generally.

Another, and more recent, of Butterfield's acquisitions is South Western Marine Factors Limited, Poole, Dorset, which incorporates Sea Sales and Marine Exports (London). South Western are factors and exporters of a comprehensive range of marine equipment, especially in relation to small and medium-sized vessels.

In addition to the parent concern, there are now nine subsidiary firms in the Butterfield organization, the trading activities of the parent firm having been transferred to W. P. Butterfield (Engineers) Limited on 1 April, 1960. The group enjoyed a moderate increase in both turnover and profit during their trading year ended 31 March last. The order books of all the subsidiaries are in a healthy state and the forward outlook for the group seems good.

Butterfields have entered into an agreement with Ryan Industries Incorporated, Cleveland, Ohio, whereby Ryan will pass on to them technical information on manufacturing techniques for cryogenic equipment in return for ordinary shares in W. P. Butterfield.

The terms of this agreement also provide that Butterfields shall have the sole manufacturing and selling rights for liquid gas vessel equipment incorporating Ryan knowledge and experience in the United Kingdom, continental Europe and West Africa.

Uses of Metal Extrusions with Integral Ends

Extrusions with integral ends are being made by Reynolds Tube Company in a range of steels and aluminium alloys. Fine tolerances are claimed for them on straightness, surface condition and concentricity.

CYLINDRICAL vessels with cross sections such as those shown on this page are being made in the United Kingdom by Reynolds Tube Company. The makers call them precision hollow extrusions, but their usefulness depends largely on their integral ends which are an interesting variation on what is normally thought of as an extruded section.

These are made in a multiple stage process consisting of an extrusion operation followed by one or more drawing operations, and the main purpose of the latter stages is to elongate the cylindrical walls obtained by extrusion.

Reynolds comment that the integral ends with their wide possibilities for internal and external forms can effect a great saving in machining and assembly costs, while the exceptionally close limits of straightness, surface condition and concentricity on the tubular portion far exceed in accuracy anything hitherto considered possible on a production basis. They add that for many purposes, including some hydraulic applications, this completely obviates the need for finish machining the bore.

Reynolds are producing such extrusions in plain carbon steels up to 0·50 per cent carbon and 1·5 per cent manganese. They will also use any of the wrought aluminium alloys. Figures quoted by the makers for steels in the cold drawn condition are shown below.

These high tensile properties are associated with better ductilities than can be obtained from equivalent specifications processed by other methods, say Reynolds. Also, impact values are generally better than those normally achieved for equivalent tensile properties.

The size range and tolerances which Reynolds claim to offer are shown in the table. They say that this is a long-run process and small quantities are not necessarily economic owing to tool cost.

Reynolds Tube Company Limited, Hay Hall Works, Tyseley, Birmingham 11.

Some of the extrusions in the maker's works; from left to right can be seen: two sizes of extrusion blanks for steel gas cylinders; aluminium air bottles; "possible requirements for steel pit props"; and aluminium extrusions for 30 litre air bottles to work at 3,000 lb per sq. in.

Steel Cylinder for Hydraulic Buffer

This is the internal hydraulic cylinder of a railway buffer. It has been made in En8D steel in runs of thousands a month for Oleo Pneumatics. The apparently non-symmetric internal configuration is really part of a 3-cornered star into which a valve unit will be seated. This basic end design is produced quite simply with the Reynolds process by having a suitably shaped end to the extrusion punch.

Steel Cylinder for Pit Prop

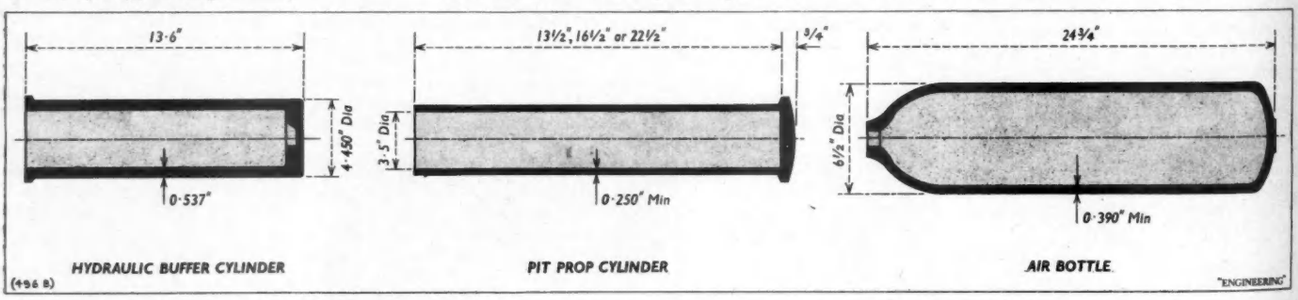
A further example of a close tolerance cylinder with an upset flange at the integral end is this one used in one of Acrow's models of pit prop.

Air Bottles in Aluminium

The most noteworthy feature of these cylinders is their capacity of 540 cu. in and working pressure of 2,400 lb per sq. in obtained with a weight of only 20 lb. They were designed in collaboration with the Admiralty Diving Unit at HMS Vernon.

The alloy used for these cylinders is an aluminium one, HE30, whose maximum strength is obtained by heat treatment. Reynolds say that such designs as this used to be made by deep drawing from a large circular blank, but the fewer operations needed when extrusion is used, and the fact that one can start with an extrusion billet in place of the more expensive aluminium plate, make the process more economical.

In production, the neck is formed after pressing and drawing operations have been carried out. It then only remains to drill out the neck to take a valve.



Properties of Carbon Steels in Cold Drawn Condition

Nominal composition		Specification	Properties, typical minima		
Carbon, per cent	Mangenese, per cent		Ultimate tensile strength, tons per sq. in	0·1 per cent proof strength, tons per sq. in	Elongation, per cent on $4\sqrt{A}$
0·15/0·20	0·40/0·60	En2	38	32	12
0·25/0·30	0·40/0·70	—	40	35	14
0·30/0·35	0·70/0·90	—	44	38	20
0·40/0·45	0·70/0·90	En8D	45	40	18
0·45/0·50	0·70/0·90	En43B	50	40	20
0·33/0·38	1·4 /1·7	En15	55	50	12
0·30/0·35 with 0·80/1·1 Cr and 0·15/0·25 Mo	0·40/0·80	SAE 4130X	60	50	10

Size Range and Claimed Tolerances

Dimension	Size range		Tolerances
	Steel	Aluminium	Steel and aluminium
Bore dia., in	¾–5	¾–8	3 and less ± 0·002 3–4 ± 0·003 4–5 ± 0·004
Outside dia., in	—	10 max.	3 and less ± 0·002 3–4 ± 0·003 4–5 ± 0·004 5 upwards ± 0·005
Length, in	40 max.	50 max.	Straightness figure: $\frac{\text{of length}}{10,000}$ are frequently maintained throughout a production run.
Weight, lb	60 max.	About 100 max.	

Chromate Brightener for Copper and Brass

An American formulation for giving copper, brass and bronze products a bright surface lustre is being sold by British licensees, Tool Treatments (Chemicals). It is called Luster-on 70 and is of the chromate conversion type, which means that it produces a thin protective film on the metal surface. This chemical bath is claimed to be non-fuming so that no ventilating equipment is required.

For producing a satin finish the concentration is 3/4 lb per gallon of water; for maximum lustre it is 5 lb per gallon. In either concentration, Tool Treatments say that the treatment cost will be below 1*d* a sq. ft. Articles need to have been degreased before treatment and will need thorough washing after treatment. The bright finish produced by the higher concentration is claimed to be useful before metal plating but it is necessary then to remove the chromate film by dipping in 10 per cent sulphuric acid or 20 per cent hydrochloric acid. Process times for Luster-on 70 are about half a minute.

Tool Treatments (Chemicals) Limited, Birmingham Road, West Bromwich, Staffordshire.

Unpainted Aluminium Bus and Trains

London Transport Executive is extending the use of unpainted aluminium to a London bus of the Routemaster type. This is being done to see how the metallic finish stands up to hard daily service, how it looks in traffic, and how the public like it.

This type of bus has its radiator cowling and "bonnet" made from reinforced plastic, so for the purpose of this test this part is having to be painted silver.

For the London Underground, it is reported that deliveries of new high-capacity "silver"—really aluminium—trains to the Central Line are going well. They are now coming into service to replace the old stock at a steady rate of three a month. By October of next year there will be 87 such aluminium trains. Apart from their modern design and improved reliability, the new "silver" trains have room for 15 per cent more passengers.

London Transport, 55 Broadway, London SW1.

Shear Characteristics of Waterstop Materials

The displacement which various designs of metal, rubber and pvc waterstops will tolerate before they fail has been measured in America by the Armour Research Foundation. These independent tests were carried out under the auspices of the Goodyear Tyre and Rubber Company and the Servicised Corporation and the results are now available in the United Kingdom on application to Tretol-Servicised.

The tests were carried out under simulated construction conditions by subjecting concrete specimens containing waterstop joints to transverse shear pressure. Each of 14 different waterstops were tested at joint separations of nil, $\frac{1}{4}$, $\frac{1}{2}$, 1 and $1\frac{1}{2}$ in, and tabulated figures of displacement and load are reported for nine of these. Three were of metal, three of rubber and three of pvc. These figures, which were obtained almost certainly on new samples of the waterstops, show the superiority of rubber and pvc dumbell designs over flat plate or bellows centre metal waterstops. For instance, at $\frac{1}{4}$ in joint separation, a 9 in bellows-centre 16 gauge copper waterstop failed in the concrete at a load of 2,290 lb (presumably, per in of length) with a displacement of 1·27 in, whereas a 6 in standard rubber dumbell failed similarly at figures of 2,800 lb and 2·89 in. In pvc a standard 6 in dumbell with the same separation failed at a load of 2,600 lb and a displacement of 3·23 in. Where there is no joint separation, the standard rubber dumbell is shown by these tests to be outstanding.

Tretol-Servicised, who market rubber and pvc waterstops among their products, say they have sold large amounts in the United Kingdom for several dam and reservoir contracts. So far as their experience shows, these tests confirm what happens in practice.

Tretol-Servicised Limited, 2 Caxton Street, London SW1.

Acceptance of New Range of Oils

Veedol (UK), who announced the availability of a new range of motor oils just a month ago, say that 500 of the 1,500 garages in London and the home counties whom they visited now stock their oils.

These lubricating oils, which are already being sold in more than 80 countries throughout the world, will be available in the following forms: 10-30 motor oil, Heavy Duty Plus 20W-30 motor oil, Premium 20W-30 motor oil, Adelbus SI series motor oil for commercial vehicles with diesel engines, and Atline 20W-30 motor oil for commercial vehicles with petrol engines. Of these, Veedol, Heavy Duty Plus is made specifically for high compression engines and is claimed to be a completely new grade.

The British company, who are part of the Tidewater group of companies headed by Mr. J. Paul Getty, have announced their intention to support motor and motor cycle racing.

Veedol (UK) Limited, Villiers House, Strand, London WC2.

User Experience with Metalworking Fluid

D. A. Stuart Oil Company (GB) market a metalworking compound called Hi-D100. They now report comments from a user as follows.

A Wolverhampton bearing company had been machining a wide bearing collar from 2 in diameter solid steel bar, producing $1\frac{1}{2}$ in bore. The whole collar was machined with grooves to take ball bearings at each end, one groove being produced by a swing tool before parting to obviate a second machine process. Until recently a light sulphurised straight oil with about 2 per cent sulphur was used, producing quite a reasonable finish with some slight tears. Replacing the straight oil cutting fluid with Hi-D100 at 20 : 1 dilution produced an excellent finish with complete absence from chatter or tear.

This compound is used at a recommended dilution of 60 : 1 for grinding operations. One bearing manufacturer is reported to have found that the onset of rust under his particular conditions occurred at a dilution of 450 : 1, thus being well within the safe limit.

It is claimed that the compound is effective for thread grinding of taps when it will give cleanliness at low cost. A machine tool company have apparently recommended that one of their clients in the aircraft industry adopts Hi-D100 for thread cutting Nimonic and stainless steel after comparative tests with other fluids.

D. A. Stuart Oil Company (GB) Limited, Lincoln Street, Wolverhampton.

Plastic Foam Usable up to 130° C

A pipe ins ulation material made from foamed plastic is now being marketed by Semtex and it is claimed to be useable up to 130° C. This means that it can be used for insulation of low pressure steam pipings which extends the range expected from plastics like foamed polystyrene. Called Foamflex, the material is made from polyurethane and is of the flexible variety. It is being made in sizes to fit pipes from $\frac{3}{8}$ in to 4 in nominal bores to comply with BS 1387: 1957.

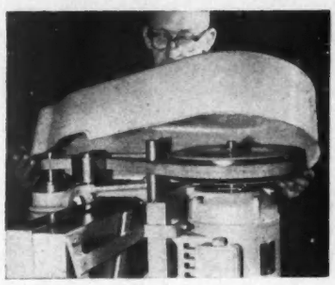
Sections of Foamflex are supplied with a slit longitudinally down one side so that they may be slipped ofer the pipe and the joint sealed with special adhesive. Overpainting is said to be unnecessary under "normal" conditions of hot and cold working.

Some of its properties are as follows: thermal conductivity, 0·22 Btu per sq. ft-hr-deg. F per in at a mean temperature of 70° F; maximum operating temperature, 130° C, minimum, — 50° C; water absorption in 24 hr, 0·59 per cent; fire rating, self-extinguishing; chemical resistance, resistant to dilute acids, alkalies and salt solutions; vermin resistance, good.

Semtex Limited, 19/20 Berners Street, London W1.

Belt Guard in Reinforced Plastic

Glass reinforced polyester is being used to make the machine guards for the Sharples Super centrifuge, say Osma Plastics who have undertaken the moulding work. The running speed of the centrifuge is between 15,000 and 16,000 rpm which can cause exceptional vibration in



the belt guard. Glass reinforced polyester has useful non-resonant properties, comment Osma Plastics, as well as withstanding corrosion from many liquids.

Osma Plastics Limited, 551 London Road, Isleworth, Middlesex.

Wooden Pattern Plates for Moulding Machine

Resin-impregnated plywood made by Venesta Plywood has now been used for five years in the moulding shop of Plenty and Son, the engineering firm in Newbury. The moulds are needed in their iron foundry. It is now reported that Plenty's are very satisfied with the performance of the plywood and are using it for nearly all of their pattern plates.

The plates are $\frac{3}{4}$ in thick in two standard

sizes, 14 in square and 16 in square They are used on a Macnab jolt-and-squeeze sand moulding machine supported only by a $1\frac{1}{4}$ in strip around the edge It is through this plate that the jolt-and-squeeze forces are transmitted to the sand which is shovelled around the wooden pattern. One of these plates weighs about 2 lb compared with the 56 lb cast iron plates used previously. The Permaply plywood plates are said to be only a quarter the cost of the cast iron ones if these are priced at £4 each.

Venesta Plywood Limited, Vintry House, Queen Street Place, London EC4.

Taking Manufacture to the Mountain

Production and installation of heat exchangers and other heavy plant for the CEGB's first lake-cooled, inland nuclear power station demand precise programming and control. An unusually high proportion of manufacture must take place on site.

WHEN they won the contract to build the Central Electricity Generating Board's projected nuclear power station at Trawsfynydd, in darkest North Wales, Atomic Power Constructions (a company owned jointly by the Fairey Company; International Combustion; Richardsons, Westgarth and Crompton Parkinson) were faced with the problem, among others, of delivering to site and installing twelve 350 ton heat exchanger shells. Since these shells were to be made at International Combustion's Derby factory, and since Trawsfynydd, the first CEGB nuclear power station to be inland and lake-cooled, is only accessible by steep and mountainous roads and lightly built bridges, it was clear that there would be a severe limitation on the size of component which could be transported to site ready made.

It followed, therefore, that a considerable amount of production would have to take place on site and that close liaison between the factory, the site workshop and the erection teams would be crucial. This liaison and integrated production planning are the outstanding characteristics of the whole project, which, for obvious technical and economic reasons, is aimed at carrying out as much fabrication work as possible at Derby.

Each complete heat exchanger shell is 18 ft in diameter by 109 ft high, and each consists of eleven strakes or rings, the biggest of them 9 ft 6 in high, and two end cones. Broadly speaking, the overall production method is to manufacture these strakes as completely as possible at Derby and then transport them and the cone ends individually to Trawsfynydd for manufacture and assembly as complete shells.

THE SHOP FLOOR

The factory production work is carried out in the new heavy fabrication shop opened by International Combustion in April, 1959. This 68,250 sq. ft shop, shown in Fig. 1, provides exceptional facilities for heavy fabrication work and has also handled work for the UKAEA's advanced gas cooled reactor at Windscale. The overall shop length is 350 ft with a central bay 75 ft wide and two wing bays 65 ft wide.

There is a clearance of 40 ft from the floor to the crane rails but additional headroom is provided for the construction of very large diameter fabrications in the central bay by a welding pit 150 ft long by 25 ft wide by 12 ft deep. On the floor of the pit there is manipulating equipment for rotating sections during seam welding, and there is also a screened off area for X-ray examination as well as the main X and gamma ray booths at the north end of the shop.

From the stock yard, raw material is routed to the main shop through the flame planer building, where the plates can be cut to size or shape, and initial weld preparations formed on their edges. Further edge preparation for welding is carried out on either a large planer taking plates up to 35 ft long, or on a table with a 25 ft long table. Circumferential weld preparation is undertaken on a large centre lathe or on a vertical boring machine. Plate bending then takes place on two vertical 3,000 ton presses (Fig. 2) which cold form the plate—varying from 1¾ in to 2½ in thick—into the 18 ft diameter strakes.

After welding, inside and out, an X-ray test is applied to the longitudinal seams and spider bracings are fitted in each strake. At this stage, until this test has been passed, only the thermal sleeve locations have been marked on the strake and the pilot holes drilled. The holes are then burnt for all thermal sleeve openings and the sleeves welded in. After satisfactory crack-detecting from the sleeve to the shell fillet weld, the whole strake, as shown in Fig. 3, is ready for stress relieving in an electrically heated "top hat" furnace at the south end of the shop.

While the strakes are being produced in this way, the 3⅜ in plates making up the petals of the cone ends are placed in a normalizing furnace after passing through the flame planer department and are then taken by special transporter bogie to a 2,000 ton downstroking press. After pressing, the petals are edge prepared and crack detected and then placed on a special assembly jig to be welded together.

The problems of heavy transportation between Derby and Trawsfynydd limit effective heavy fabrication production on the heat exchanger shells to single strakes and cone ends, the latter, at approximately 30 tons each, being the heaviest individual items delivered to site. The tube elements, which must also be dispatched to Trawsfynydd for assembly into the completed heat exchangers, are produced meanwhile in a shop adjacent to the heavy fabrication shop. There, the manufacturing process is one of degreasing, edge preparation and cold bending, followed by assembling and welding the tube lengths on special bed plates. The complete tube element assemblies are mounted on jigs to establish correct dimensions, and the elements are hydraulically tested, internally dried, and finally vacuum tested to check that there is not a leak rate of more than two cusecs.

Transportation from factory to mountainside must also be arranged for other International

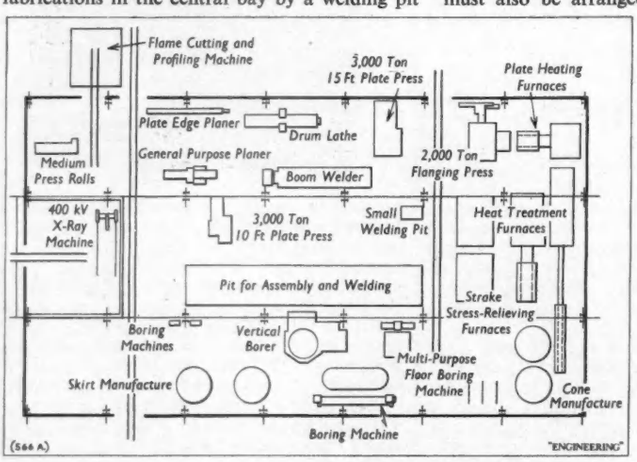


Fig. 1 (left) Layout of the heavy fabrication shop at International Combustion's Derby works. Total floor area is 68,250 sq. ft.

Fig. 3 (right) General view of the heavy fabrication shop. In the foreground is a strake ready for insertion in the adjacent stress relieving furnace.

Fig. 2 3,000 ton vertical press cold bending 2½ in plate to form strakes 18 ft in diameter.

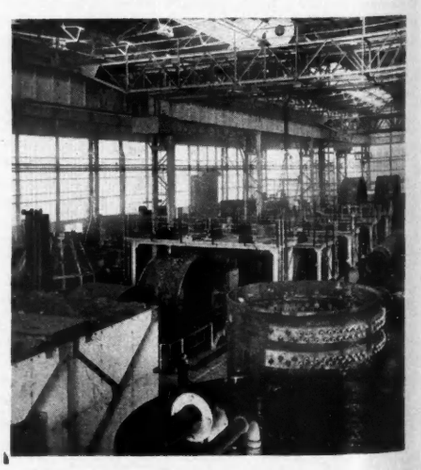
Combustion products, including 4,000 ft of 5 ft 6 in diameter main gas ducting to run between the heat exchangers and the reactor vessels; various components in the biological shield cooling system; reactor pressure vessel attachments, such as standpipes and ducts; CO_2 storage vessels; and filter vessels. Thus, there is a complicated production programme to be integrated within the factory itself apart from the special problems arising from the division of production between the shop floor and the site workshop.

BY ROAD, SEA AND ROAD

Heat exchanger strakes and cone ends travel to Trawsfynydd in three stages. They are taken by road from Derby to Liverpool and then, by small coastal ship, around the North Wales coast, past Anglesey, to Portmadoc. This was once a thriving harbour for the Ffestiniog slate industry but, understandably, was not equipped to handle 30 ton fabrications for a nuclear power station. After a CEGB investigation, it was decided to develop the harbour and to install a 150 ton crane on the quayside to off-load the heat exchanger components.

However, even with these improved harbour facilities, ships of the necessary size can only enter Portmadoc harbour for three to four hours on either side of high water, during a period of five to seven days before and after monthly high spring tides. Careful programming is therefore very necessary to ensure a steady flow of equipment to the site fabrication shops in the correct sequence. Not many production schedules have to allow for this sort of condition.

It has also been necessary to design special equipment to turn the strakes over during transhipment—a formidable task with components of this size—because of the different conditions on the Derby-Liverpool road and the Portmadoc-Trawsfynydd road. On the former journey, height restrictions necessitate carrying the strakes



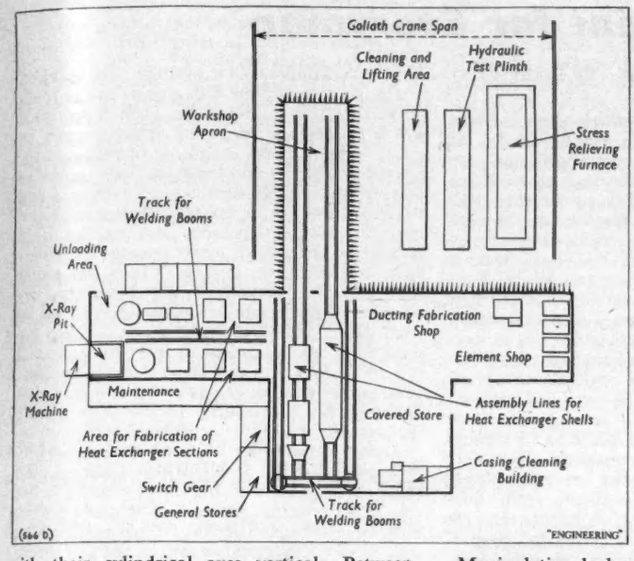


Fig. 4 (left) Layout of International Combustion's site workshop at Trawsfynydd. It is 400 ft long by 160 ft wide.

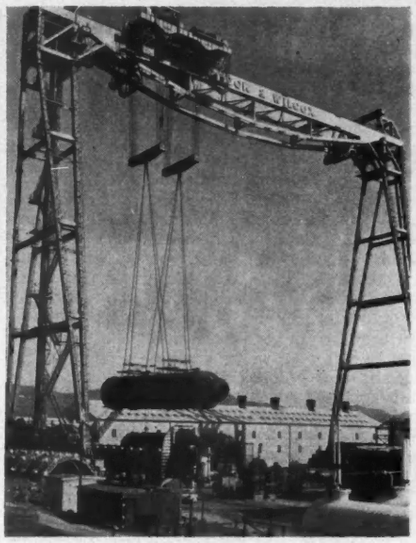


Fig. 5 (right) The 400 ton Goliath crane lifting a 350 ton heat exchanger shell. Another shell is shown in the open stress relieving furnace. The 250 ft high crane hook-up is often lost in mountain mist.

with their cylindrical axes vertical. Between Portmadoc and Trawsfynydd—twelve miles of road that have had to be improved extensively—on the other hand, width restrictions make it necessary for the strakes to travel with axes horizontal.

In this latter position, the load has an unusually high centre of gravity and a special ballasted trailer has to be used to avoid the possibility of overturning on the road, which has a 1 in 12 cross fall at one point. The road reaches a gradient of 1 in 7, and two heavy duty towing vehicles handle the component and ballast combined weight of approximately 50 tons.

The planning and timing of the journey from Derby to Trawsfynydd are obviously a vital part of the overall production schedule.

SITE WORKSHOP

On site, Atomic Power Constructions' team of planning engineers have overall responsiblity for coordinating and integrating the work of the various manufacturers and contractors. Using programming and control aids, such as bar charts, they ensure that supplies and production keep to schedule—a task made difficult by the number of contractors and sub-contractors, the division of production between remote factories and site workshops, and the inaccessibility and restricted working conditions of the site.

The Atomic Power Constructions role, however, is essentially a control and inspection function rather than a manufacturing function. The individual contractors, subject to the general control requirements, are responsible for the management of their own on-site manufacturing installations.

International Combustion's site workshop, shown in layout in Fig. 4, is a "T" shaped building 400 ft long and 160 ft wide. Within the buildings are areas for heat exchanger and ducting fabrication and for element cleaning, as well as for the usual services of storage, maintenance, laboratory work and administration. Building this workshop was complicated by the lack of level ground—there was a 50 ft drop between some points—for the workshop and the length of track required for the attendant Goliath crane, supplied by Babcock and Wilcox.

Making a large enough area of level ground on such a mountain site was very expensive. Indeed, it is said that a square foot of level ground on the site costs as much as a square foot in Bond Street.

When strakes arrive at the Trawsfynydd workshop, they are passed into the fabrication area, placed on manipulator beds and welded together in pairs, using boom welding equipment on rail tracks for the outside seam welds and special portable equipment for the inside welds. Using a 60 ton overhead crane they are then transferred to one of the two assembly lines shown in Fig. 4, after being checked by X-ray.

Manipulating beds and internal and external welding equipment, similar to those in the fabrication section, are used in final assembly of the heat exchanger shells. During final assembly, the spider bracings inside the shell remain in position in order to provide adequate support during the later stress relieving operation.

After fabrication in the site workshop, the heat exchanger shell, comprising eleven strakes and two cone ends, is slid on bogies out of the shop and under the Goliath crane track. This 400 ton crane, with a 250 ft hook-up, then lifts the completed shell and places it, still horizontal, in the adjacent stress relieving furnace, as shown, rather dramatically, in Fig. 5.

When it has been placed in position in the stress relieving furnace, thermocouples are fastened to the shell at internal and external points and connected to instrument panels in an adjacent control cabin. Metal temperatures are closely watched and controlled. The furnace roof, consisting of 15 five-ton sections, is replaced on the furnace body and sealed.

Two oil-fired combustion chambers, one at each end of the furnace, provide hot gas which a re-circulating fan discharges through the ducting into the shell. It is heated from ambient temperature to 600° C, held there for five hours, and then allowed to drop back to ambient. Depending on the prevailing weather conditions, the whole process takes about seven days. When the twelve Trawsfynydd heat exchangers have been treated in this manner, the furnace can be dismantled and removed to another site comparatively quickly and economically.

When stress relieving has been completed, the Goliath crane is used again to lift the shell from the furnace and lower it on to the nearby hydraulic test plinth. Metal caps, used to cover the thermal sleeves during stress relieving, are removed and replaced by screwed steel covers to withstand the hydraulic test pressure of 460 lb per sq. in. Eight hundred tons of Trawsfynydd lake water, heated to maintain a reasonable shell temperature and poured into the vessel in stages, provide the hydraulic medium and a three ram pump steps up the pressure.

After testing and emptying, the heat exchanger shell is lifted again by the Goliath crane and transferred to the cleaning and lifting plinths. The end domes and internal spider bracings are removed, and the inside of the shell is shot-blasted from end to end, special seals preventing contamination of the clean areas. Permanent supporting steelwork for the tube element banks is installed, and the interior of the vessel is painted to keep it clean.

The next operation is to lift the 350 ton shell on end and deposit it on its prepared plinth in the reactor building, the civil and the production engineering work having been coordinated by the Atomic Power Constructions staff so that the building is in a suitable state to receive the heat exchanger. A tail-car structure, designed to take a maximum load of 70 tons, is used to guide and control the lower end of the vessel while the Goliath lifts it upright. The heat exchanger shell is then lowered into position in the reactor building, an operation in which this crane needs its exceptional hook-up height and, indeed, it can lift a vertical heat exchanger over the reactor building. This means that the order of installation can be varied, if need be — one of the ways in which the choice of a Goliath crane has made for flexibility.

When the first heat exchanger was lifted into position at the end of June, mountain mist hid the crab and the crane driver from view and the operation had to be directed by telephone.

IN SITU FINAL ASSEMBLY

Before the tube elements and other internal fittings are placed in position inside the heat exchanger shell, a "clean conditions hut" is lifted into position—by the Goliath crane—on top of the vessel. This hut, a building as big as a fair size house, prevents the ingress of foreign particles to the shell interior, and it is fitted with an air lock to maintain pressure in the shell at a slightly higher level than atmospheric pressure. It includes, too, dehumidification plant, together with changing rooms for personnel.

The tube elements, which have been acid cleaned and cannistered in the site workshop, are then lifted into the clean conditions hut where the cannisters are removed and the elements lowered into the vessel. When all the tube elements have been placed in position, the ends of the heat exchangers are sealed and the hut removed.

Installation of the twelve heat exchangers—six for each of the two reactors in this 500 MW power station—has been one of the many (albeit one of the more difficult) production programming and control problems encountered on site by Atomic Power Constructions. It has required coordination between distant factory and on-site workshop and between a diversity of contractors and sub-contractors, and it has also been necessary to allow for such factors as tide conditions in Portmadoc harbour and mountain mist at Trawsfynydd. For International Combustion, there have been the production management problems of manufacture at Derby and Trawsfynydd, problems which they have overcome to such effect that they are now able to build a heat exchanger faster than the scheduled time.

Two of the heat exchanger shells are already in position in the reactor building and a third will be installed within the next few days.

Atomic Power Constructions Limited, 28 Theobalds Road, London WC1.
International Combustion Limited, Derby.

On the Shelf

By Frank H. Smith

WHY do people cease to be realistic when they have achieved some sort of power? Quoted in *Aviation Week*, Trevor Gardner, a pretty big shot in the US aerospace programme, said ". . . a nation which spends some 40 billion dollars a year for amusements, and some 11 billion dollars a year on advertising of its amusements and products, clearly has the resources to support a major space program. By no stretch of the imagination can it be argued that a major space program is a more trivial enterprise or one less certain to produce lasting satisfactions than either of these sinks for our excess energy and wealth." I would suggest that Mr. Gardner tries standing somewhere else to get a different viewpoint. Any long-playing record of any symphony orchestra will beat a space program for lasting satisfaction for a start.

A delicately hued pea-green folder is available from National Lending Library for Science and Technology, Boston Spa, Yorkshire (learn that lot because I shall not give it in full for long, if any more) entitled *Russian Translating Programme*. Its issue was accompanied by a crafty tie-up with the Soviet Exhibition at Earls Court. I'm all in favour of a bit of opportunism and the best of luck to Boston's Pa.

We who remember the old £395 homesteads of before the war get a bit nostalgic when we see names of those days associated with contracts like airfields and scar-making motorways; which is my lead-in to a new house journal called, simply, *Build*. It is the journal of Wates the builders and if you want to get on the mailing list write to Press and Public Relations Limited, Ferguson House, 15-17 Marylebone Road, London NW1, who tell me that *Build* constitutes a complete breakaway from the traditional house journal. Get No. 1 TODAY and find out HOW. How? Ugh ! (Heap big pow wow talk.)

I am sorry that due to back o' the drawer skulking I omitted to draw attention to a paper to the North-East Coast Institution of Engineers and Shipbuilders (Bolbec Hall, Newcastle upon Tyne) last December by their Secretary (T. S. Nicol) called, simply " The Institution." Those of you who collect this sort of thing may still be able to get a separate. There's room for a book on all the engineering institutions—or am I late with the suggestion?

Aback-taking it was to read *First Annual Report of the Council of the Institute of Physics and The Physical Society* until one realised that the " first " here referred to their amalgamation. This first report can well become quite a historic document since it sketches the background of the " merger."

As you will know, I have a soft spot for historical material and I noted with satisfaction " The First Hundred Years of Australian Engineering Education 1861-1961," by the Professor of Engineering at the Royal Military College, Duntroon—A. H. Corbett. It appeared in the *Journal of the Institution of Engineers, Australia*, for April-May.

In September a second edition of a new stinks dikker comes out, with Fouchier and Billet's *Chemical Dictionary* from Netherlands University Press, Amsterdam. Eng.-Fr.-Ger., Fr.-Ger.-Eng. and Ger-Eng.-Fr. Bung in your order now to H. K. Lewis and you get it a pound cheaper than after September, for £8 5*s* 0*d*.

Ignore those past references (if any) to the periodical *Live Deadlines* (which listed forthcoming meetings, last dates for papers and so forth). It is dead as of 9 June.

As I write these words I contemplate two weeks' holiday but you will not notice any difference. The column must go on. But not out of consideration for the reader. No sir. I don't want my kids to starve. But if tobacco gets much dearer they'll have to take a chance.

Management for Everyman

The Business of Management. By ROGER FALK. *Penguin Books.* (3*s* 6*d*)

Technical change and the development of new management techniques are making the job of managing an increasingly complicated task for the average business. The average business is a small business, with limited resources of capital, time and management expertize to try out increasingly elaborate management devices.

It is the great merit of this book that it approaches the average company where it is. It offers a readable and reliable guide through the generality of management problems which face managements and makes telling but modest claims for the use of sound management principles. For Mr. Falk those principles are based on something deeper than humanity of outlook, the need to face change courageously and systematically in a changing world and a willingness to tackle management problems objectively.

Owners of small businesses are rarely likely to bother to learn management from textbooks. They have in most cases neither the time nor inclination to study management once it strays to any extent from their daily experience. There are exceptions to this, of course, but such is the general attitude. If it were otherwise the average standard of management would be much higher than it is today. Many of them could well read this book however, for it travels modestly and with clarity and it neither preaches nor tries to offer an intensive reading course in management. It hints at a healthy dislike on the author's part of management jargon as developed in the voluminous literature on the subject.

The book is written with an eye on the small business. This is indeed the great fallow field where productivity in British industry must be raised today. There are plenty of problems for the big companies and the large trade unions to face in raising their standards of enterprise and flexibility, but the big mass of conservative and outdated business practice lies in the large number of small firms where nepotism, indifference and defeatism are rife. It is the sound thought behind much of this book that no business in the conditions of today runs on by itself like a well-oiled machine—or, to keep the metaphor, can be worked to rust and scrap like old machinery for the benefit of the present generation—because the pace of change is too fast even for the security of many of today's incumbents.

Those sections of the book dealing strictly with management problems are stronger than those which deal with questions of finance but this is not a serious blemish. The case histories have been well chosen and interestingly written up. If the author revises any of the text in the future he might consider bringing a few more case histories into it rather earlier in the book. It remains an excellent introduction to management and it is cheap enough for companies who take their management difficulties seriously to acquire several copies and circulate them to key top and middle management staff—and to other working proprietors.

G. E. TEWSON

Putting Words in Order

A Guide to Technical Writing. By C. BAKER. *Pitman.* (15*s*)

Editorial Practice in Libraries. Edited by B. C. BROOKES. *Aslib, 3 Belgrave Square, London, SW1.* (27*s* 6*d*, *Members* 21*s*)

To suggest that it is possible to become a skilled engineer, doctor, solicitor, or accountant, just by natural talents, without several years of training, is to court laughter. Yet it is a well-known fact that " any fool " can write directions for the use of a machine tool, a report on a technical subject, or even the minutes of a meeting of directors. This flattering universal truth is one reason why so many executives complain that their desks remain piled high with documents that they never have time to finish. If they were written in precise, straight-forward English, with plenty of concrete examples of abstract principles, the whole spiced with an occasional flash of humour, many more documents would get read quickly, and many more would be followed by the energetic action which is the optimistic hope of those who write them.

The English language has a larger vocabulary than any other. It is, therefore, an instrument capable of expressing shades of meaning with particular precision. But if a writer is to achieve this subtlety and precision, he needs, first, to have thought out his ideas clearly, and secondly, constant practice to perfect the use of his instrument. If he fails to observe either of these conditions, the very richness of the language, and the apparent looseness of its grammatical constructions, leads him into the slipshod verbosity and the wooliness, shot through with clichés, characteristic of so much that piles up on our desks.

Modern industrial processes and scientific achievements lead to ever growing " paper work " to ensure that the necessary operations and observations follow the procedure required and achieve the results desired. Much of this is written by those who initiate the work that they describe but, in a large industrial or commercial enterprise, more is by technicians who specialise in writing. It is to these two groups that Mr. Baker addresses his excellent little 100-page manual.

Mr. Baker's chapters cover all forms of technical writing: explanatory documents, manuals, brochures, reports, specifications, publications for training employees; the training and characteristics of good technical authors: style; the user: information between equals, information for a superior, information for workshop and site, readers in general; English composition and grammar: notes on presentation; mental planning: thinking before writing, dictation; the use of illustrations: photographs, engineers' drawings, artists' work, annotations for foreign reproduction; writing copy for publication: collecting information, first draft, revisions, memory aids; report writing; specifications; lectures; journalism and advertising; foreign translations; how to see a manuscript through the press; economics and management: economy of manpower when a team of writers is employed, cost of reproduction, and copyright.

Mr. Baker is careful to illustrate his precepts with concrete examples. Thus, among many others, he cites the following piece of horrible technical writing:

> " All manner of different water agitators can be employed but, for the moment, ignoring the torque required to overcome standstill friction, they all have one thing in common, and that is that the torque increases according to some power of the speed with the actual index probably varying between 2·5 and 3."

On this Mr. Baker comments: " Circumlocution such as *for the moment* or *and that is that* are superfluous and fogging. They lengthen the sentence and break up the theme. The blue pencil must be wielded freely. Here is a first effort at recasting the sentence—

> " Various water agitators can be used and, disregarding standstill friction, all have a torque which increases by a power of the speed—probably an index between 2·5 and 3."

Technical writing, Mr. Baker reasonably insists, is but a specialised adaptation of good English prose. It is, therefore, essential that

a technical author should be able to appreciate the quality, and faults, of English literature, but, provided he chooses a reasonably high standard, it matters little whether he reads the classics, poetry, history, lighter contemporary novels, or well-written accounts of current affairs. Good writing follows good reading and the wider the variety, the wider is the general outlook. The constant pursuit of specialised writing can narrow the mind. The writer lacks variety of ideas; his thinking and expression sink into a rut and follow with monotonous similarity that which went before; the reader has to make a conscious effort of concentration to struggle with that which is to come. A style may be technically impeccable but its too frequent repetition wearies the reader and makes him less receptive to the real message which the document is intended to convey.

It is interesting to note that this appeal to the technical writer to widen his horizons is one which recurs in all manuals offering advice on how to increase efficiency in any profession. The man who gets to the top in engineering, for example, is not one who is merely a master of technical expertise, but who brings to his work the same imagination, enriched and enlivened by a knowledge of men and current affairs, and wide reading outside his own subject, that Mr. Baker urges the ambitious writer to cultivate.

More and more industrial and commercial enterprises find it necessary today to set up part or whole-time editorial departments to issue house organs, prestige periodicals, or other publications. Any who wish to qualify themselves for a post in such a department, or who, being already in one, wish to increase their output and efficiency, could profitably study *Editorial Practice in Libraries*. They should not be put off by the slightly misleading title, which suggests that the utility of the contents is limited to those who work in a library: the technical editorial and publishing practices described are, in fact, those used in any technical publication.

Ten specialists contribute clearly written and informative chapters on the organization of an editorial department; the several processes of printing; the problems of successful print buying; layout and design; editing a manuscript; the preparation of illustrations; the organization, economics, and technicalities of publishing in general, and of publishing a specialised journal in particular.

Both books are plentifully illustrated with instructive diagrams and drawings (*Editorial Practice in Libraries* has also twelve well reproduced photographs). Both contain useful bibliographies. Both are cheap at the prices asked.

JOSSLEYN HENNESSY

Production Engineering

Rezeptbuch für die Maschinen- und Metallwarenindustrie. By HUGO KRAUSE. 7th Edition. *Carl Hanser Verlag, Kolbergerstrasse 22, Munich 27.* (14·80 *DM*)

Die Arbeitszeitermittlung der Verzahnungarbeiten. By W. BÜLTMANN. *Springer-Verlag, Heidelberger Platz 3, Berlin-Wilmersdorf.* (33 *DM*)

Modellversuche an Werkzeugmaschinenelementen. By HERWART OPITZ and JOHANNES BIELEFELD. Forschungsberichte des Landes Nordrhein-Westfalen, No. 900. *Westdeutscher Verlag, Ophovener Strasse 3, Opladen/Rhld.* (21 *DM*)

Production engineering is still not the sort of subject one dares to mention in the best academic circles. Management studies yes, provided, of course, they have as little as possible to do with technology and are more concerned with what might be called the "metaphysics of production" than with engineering. Production engineering, however, is not *basic* enough and is too much concerned with techniques for it to attain academic respectability.

Admittedly, the universities are not held in high regard in the best (i.e. the most practical) production engineering circles either. Those "long haired boys" appear to be concerned with *basic* questions, far removed from the daily problems of industry. They don't seem to give the sort of answers the practical man requires.

These reflections are occasioned by the accidental meeting of three books in the hand of one reviewer: three books which appear to have nothing in common, except for being concerned with topics which fall into the general field of production engineering and for being written for three different types of engineers, all of whom are needed in the production process.

Hugo Krause's book is, to be sure, the type of book the practical production engineer considers as ideal. It is, as its title appropriately summarizes, a *Book of Recipes for the Machine Building and Metal Working Industries*. In the course of its six previous editions, it has been enlarged to contain 600 instructions, grouped in seven chapters and dealing with the following topics: Foundry practice, alloying of metals, machining and forming of materials and the maintenance of machines and tools, heat treatment of steels and metals, welding and other joining methods, cements and glues, surface treatment for the avoidance of corrosion and improved appearance, plastics and other non-metallic materials. There is an extensive index.

It is a mine of information which is interesting to read even for someone who normally does not worry as to how leather can be glued to iron or aluminium, or which are the best alloys for gongs, to mention only two of the 600 entries.

W. Bültmann's book on *The Determination of Production Time in Gear Manufacture* is a very different book. It is written for production engineers who are concerned with single and series production of spur and bevel gears and worm drives. This is by no means a book which can be digested by cursory reading, which is not altogether surprising considering the complexity of gear manufacture. It describes the machines and tools used for gear production and shows how production time can be estimated with the aid of simple mathematics, tables and nomographs. The methods of calculation are illustrated by a number of well chosen examples. The book is very well produced, containing a fairly long list of books and periodical references but no index. Oddly enough, the periodical reference list contains only German publications.

This is a book which is extremely unlikely to become an undergraduate textbook, but it should, in parts, be included in post-graduate production engineering studies. It presents gear manufacture to be one of the fields of production engineering which demands a wide basic foundation in certain aspects of the machinability of metals and the theory of gears. It might usefully be read by those who have not yet made up their mind whether graduates are really needed in production engineering, showing that for the running of a modern gear plant men with high intelligence and an engineering background are required, irrespective of what their paper qualifications may be.

The Research Report by H. Opitz and J. Bielefeld on *Model Analysis of Machine Tool Elements* is a summary of work carried out over a number of years in the machine tool laboratory of the Technological University of Aachen, Germany. It contains little that has not already been published in a number of journals and which is therefore not already known to research workers concerned with this field. It is nevertheless a useful introduction to model techniques in machine tool research, which, incidentally, shows how little the subject has advanced since its original inception.

This is a publication which is primarily aimed at machine tool designers, being concerned more with the practical results of particular model investigations than with the actual techniques for carrying these out. A book dealing with the fundamental aspects of these techniques remains to be written, and there has never been a greater need for such a publication than at the present time. It may well be that the negligible progress achieved since those first few papers mentioned in this report appeared is due to the lack of fundamental work on model techniques in general.

Three books on diverse topics, covering the wide gap between the practical and the fundamental: production engineering is a big enough field to accommodate all tastes and interests. Its scope goes far beyond the range of these books, embracing all sciences concerned with machines and the men working them. There may be more glamour and prestige in rockets and reactors, but wealth is created not by these but by the process of production.

S. A. TOBIAS

Rubber as an Engineering Material

The Applied Science of Rubber. Edited by W. J. S. NAUNTON. *Edward Arnold.* (£8 8*s*)

Engineering Design with Rubber. By A. R. PAYNE and J. R. SCOTT. *Maclaren and Sons.* (50*s*)

Microscopy of Rubber. By C. H. LEIGH-DUGMORE. *Published for the Institution of the Rubber Industry by Heffer.* (25*s*)

Introduction to Natural and Synthetic Rubbers. By D. W. HUKE. *Hutchinson.* (25*s*)

During the past few years there has been growing recognition that rubber compounds can in many ways be regarded as engineering materials; that is, certain basic properties can be specified within reasonable tolerances which can be maintained during manufacture. This is largely the result of accelerated research and development programmes over the last ten or fifteen years, which have influenced this state of affairs in two directions. In the first place it is now possible (in respect of certain properties) to accept tolerances that would have been impossible in pre-war years; in the second place the availability of many new materials has enabled elastomeric materials generally to meet conditions of service considered intolerable only a few years ago. The term "elastomeric" is used deliberately, in view of the fact that the dividing line between "rubbers" and "plastics" has virtually disappeared owing to so many recent developments.

From some points of view the rubber industry has accumulated knowledge at a greater rate than its customers have become aware, even when those customers have an engineering background. Attention was drawn to this situation by H. F. L. Jenkins and F. Bastow in ENGINEERING, 10 April, 1959, in their review "Specifications for Rubber Products—A Call for Rationalization."

It can, of course, be argued that this state of affairs results from the scarcity of published material reviewing the state of current knowledge in the rubber industry, making clear what is now possible in an engineering sense. However,

in the last year or so several books have been published which go a long way to repairing any such deficiencies. Four which have recently appeared review different aspects of the industry and two of them contain reference material of much value to the engineer.

With the approval of the Institution of the Rubber Industry, Dr. Naunton has performed a valuable service in persuading twenty-five recognized authorities in the industry to review the present position in their specialist fields. As editor, he describes this publication as "an advanced comprehensive textbook of rubber technology," combining theory and practice. This is an excellent definition of the field covered and it seems highly probable that it will be a standard reference work in the industry for many years to come. There is a very comprehensive list of references behind each chapter, together with a useful name index, although the subject index is rather scanty for a work of this calibre.

It might be thought that *The Applied Science of Rubber* would be of more value to the practising rubber technologist than to those outside the industry. However, Chapter VIII, Part One, "Elasticity and Dynamic Properties of Rubber," Part Two, "Practical Application of the Dynamic Properties of Rubber," and Chapter IX, Part One "Physical Testing of Rubber," Part Two, "The Testing of Finished Products," amounting to 272 pages in all, contain much valuable information both to the student and practising engineer. Eight guineas is perhaps rather a lot to pay for those who only need this section, but the complete publication can be regarded as a necessity for industrial organizations in any way linked with the rubber industry and as a desirable acquisition for the engineering library.

The publication *Engineering Design with Rubber* can be considered as linked with the Research Association of British Rubber Manufacturers, since Dr Scott served with this organization for 35 years (the last 18 as Director) and Mr Payne is a Senior Scientific Officer in the Physics Division. The book is based on material presented at a three-day symposium organized by R.A.B.R.M. in October, 1958, and repeated again in December, 1958, under the title "Dynamic Design with Rubber." The authors state in their foreword that this publication is "a fuller account of the whole subject of dynamic properties and design with rubber, such as would form a practical manual for the guidance of all those . . . faced with problems in rubber engineering design."

The book certainly meets this specification very closely. It contains eight chapters and three appendices, each contribution reviewing one of the engineering aspects of rubber in a comprehensive way. The mathematics are dealt with very adequately, much useful factual information is tabulated, references are quoted and a subject-index is of value. From the engineer's point of view, this publication should be widely consulted whenever it is desired to determine the best way to use rubber components in a project under review.

Mr. Leigh-Dugmore (who is also one of the contributors to Dr. Naunton's textbook and a member of the Dunlop research organization) deals with a very specialised aspect of rubber technology, but does it in a most lucid way.

In the last decade the techniques of examination by the light microscope have been supplemented by those of the electron microscope, with the result that much more is now known about the structure of rubber polymers and compounds and the mechanism by which various ingredients influence specific properties. Mr. Leigh-Dugmore reviews both the knowledge gained by these new techniques and the way in which this knowledge has been acquired.

The monograph contains some most interesting electron photo-micrographs and is also well supplied with references, author index and subject index. Apart from its value to the rubber technologist, it can be recommended as an excellent example of technical presentation.

Mr. Huke's book is in a different field to the previous three publications, in so far as it is intended not so much as a textbook for engineers and rubber technologists, but as a reasonably non-technical introduction to the basic characteristics of natural and synthetic rubbers. It also contains a brief review of the manufacturing processes for rubber products, together with the author's views on the future of rubber. It includes a classified bibliography, a detailed subject-index and a glossary of technical terms which will be particularly useful to students.

This publication is obviously aimed at the student and the non-technical reader, who wishes to become reasonably familiar with the relationships between natural and synthetic rubber and the terms employed in discussing them. It is not intended as a reference book for practising technologists and the word "Introduction" in the title well defines its scope.

These four publications should go some way to remedying the deficiencies referred to by Jenkins and Bastow, at the beginning of this review. They would go a lot further if they were to become widely used by engineers who have need to employ the unique properties of elastromeric materials in solving specific problems. This applies particularly to *Engineering Design with Rubber* and to a lesser degree to the appropriate chapters in *The Applied Science of Rubber*. *Microscopy of Rubber* is a rather specialised publication of an excellent type, and *Introduction to Natural and Synthetic Rubbers* a useful book for newcomers to the industry. Studying published material is of course no substitute for practical experience, but nevertheless provides an excellent foundation for a closer understanding between engineer and rubber technologist, which can only be of mutual benefit.

P. D. PATTERSON

Trade Publications

Copies of any of the following trade publications are obtainable from the addresses given, though distribution is sometimes restricted.

Electrical Power

Package Switchgear. SOUTH WALES SWITCHGEAR LTD., Blackwood, Monmouthshire. Catalogue leaflet describes the Type UE1 single and duplicate bus-bar metal-enclosed 33 kV switchgear for distribution and power station extra high voltage duties up to 1,000 MVA and 2,000 A. General design and installation features are brought out, with some detailed construction references. 20 pp. ill.

Motors. BROOK MOTORS LTD., Huddersfield, Yorkshire. Booklet covers a wide range of power units, giving details of constructional variations for normal, dust-laden or explosive atmospheres. An electrical modifications section provides data on reversing, multi-speed and intermittent rating characteristics. 16 pp. ill.

Equipment for Cement Plants. WESTINGHOUSE ELECTRIC INTERNATIONAL COMPANY, 40 Wall Street, New York 5, NY. This booklet includes sections on electrical distribution apparatus, control centres, motors and drives, maintenance services and research being conducted in the company, in connection with the cement industry. 16 pp. ill.

Transformers and Rectifiers. HACKBRIDGE AND HEWITTIC ELECTRIC CO. LTD., Walton-on-Thames, Surrey. Two publications: DB5/6 describing large transformers, with notes on cooling arrangements, manufacture and applications; and R193/2, dealing with silicon and germanium rectifiers, with reviews of semi-conductor applications in electrolytic processing, light and power, and traction. Choice of type is clarified, and examples of duty and application are given. Respectively, 24 and 20 pp. ill.

Traction Batteries. CROMPTON PARKINSON LIMITED, Crompton House, Aldwych, London WC2. Brochure is devoted to a new type of battery of tubular construction with higher ampere-hour capacity, size for size, than before. Details of two types are given, and booklet in back-cover pocket contains technical data. 8 pp. ill.

New Books

A Manual of Spherical and Practical Astronomy. By WILLIAM CHAUVENET. 5th Edition. 2 Volumes. *Dover Publications, New York; Constable, London.* (44*s*)

Unabridged republication of the final, revised edition (1891) of this standard work. Volume 1 takes up the general problems of spherical astronomy and their applications to nautical astronomy. The theory and use of fixed and portable astronomical instruments are treated in Volume 2. A detailed proof of Gauss's method of least square is appended.

Selected Papers on Stress Analysis, presented at the Institute of Physics Stress Analysis Group Conference, Delft, 1959. *Published on behalf of the Institute by Chapman and Hall.* (50*s*)

Eighteen of the 51 papers discussed at the conference are presented in their original form and language (English, French or German). An English summary of the remaining 33 papers is appended. The main topics of the conference were methods of stress analysis and their applications.

Statically Indeterminate Structural Analysis. By R. L. SANKS. *Ronald Press Company, 15 East 26th Street, New York 10.* ($10)

Although this is primarily a textbook for undergraduate courses, enough advanced material is included to make it suitable for postgraduate and reference work. The methods of moment area, virtual work and moment distribution are fully covered, and some other well-known methods (e.g. the Williot-Mohr diagram, elastic weights, etc.,) are introduced. There is a section on models and a 59-page appendix devoted to problems—answers to some of which are given.

Optics and Optical Instruments. By B. K. JOHNSON. *Dover Publications, New York; Constable, London.* (13*s* 3*d*)

The practical applications of elementary optical principles are described. Working models of telescopes, microscopes, photographic lenses and projection systems are explained and illustrated, together with experiments for measuring the usual optical parameters. The working of optical glasses is also considered.

The Reviewers

Mr. G. E. Tewson, M.A., is partner in the firm of O. W. Roskill, Industrial Consultants, and was formerly editor of a business magazine.

Mr. Jossleyn Hennessy, M.A., is an economist, broadcast commentator and London editor of the *Eastern Economist*, New Delhi. He is the author of several books.

Professor S. A. Tobias, D.Sc., Ph.D., M.A., is Head of the Department of Mechanical Engineering at the University of Birmingham. He is author and co-author of papers on linear and non-linear vibration and on machine tool chatter. He is an A.M.I.Mech.E. and M.I.Prod.E.

Mr. P. D. Patterson, A.I.R.I., is manager of technical presentation in the Public Relations department, at the Dunlop research centre. During the Second World War he served with the Ministry of Economic Warfare and subsequently was in charge of the restarting of the rubber and plastics industries in the Ruhr and Rhineland. He is a member of the Association of British Science Writers.

Essentials of Heat. By O. M. WHITE. *Cleaver-Hume Press.* (15*s*)

Concise and with the emphasis on practical applications, this textbook confines itself to the essentials of the subject as reflected in the latest demands of the GCE A-level examinations. A variety of problems is appended to each chapter for descriptive or numerical treatment.

Symposium on Radiation Effects and Radiation Dosimetry. ASTM Special Technical Publication 286. *American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa.* ($4·75, *Members* $3·80)

Some of the latest research on the effects of radiation on the physical and chemical properties of materials is presented, including discussions of the parameters to be considered in predicting and evaluating these effects. The dosimetry contributions cover high-intensity gamma-rays, solid-state ionization chambers and neutron measurements.

Marketing

New Commonwealth Contracts for British Firms

AT A time when criticism is being levelled at Britain for failing to make full use of the potential market for goods and services offered by the development of resources within the Commonwealth, there comes news of British firms receiving substantial contracts from Australia and New Zealand.

BRITISH INSULATED CALLENDERS CABLES Limited who already hold a $7,000,000 contract with the MAGNA PIPELINE Company Limited of Vancouver to manufacture and install 53 miles of flexible submarine pipeline for the transmission of natural gas from the mainland to Vancouver Island (ENGNG., 20 Jan. '61, p. 130) are now to establish a power link across the Cook Straight between the North and South Islands of New Zealand.

The contract, valued at approximately £2,700,000, has been awarded by the New Zealand Electricity Department and covers the manufacture and installation of 76½ miles of submarine gas filled power cables together with terminations, accessories and spares. Three single core cables will be laid giving a rated load capacity in the circuit of 600 MW at 1,200 amperes. Commercial service is scheduled to commence in April, 1965. The cables will be laid in continuous lengths from an ocean freighter specially adapted for cable laying with machinery manufactured by TELCON (GREENWICH) Limited, a member of the BICC Group.

A £3,500,000 contract has been secured by NOYES BROTHERS Limited, the Australian subsidiary company of CROMPTON PARKINSON Limited. The order, given by AUSTRALIAN CEMENT Limited, covers the design, supply and commissioning of extensions to the existing Geelong Works.

Power Manipulators for Decontamination

THE GENERAL ELECTRIC Company Limited has received an order from the United Kingdom Atomic Energy Authority for a remote handling installation to be used in the decanning and decontamination caves at the Windscale reprocessing plant, Sellafield, Cumberland. Its purpose will be to handle the irradiated fuel elements as used in the Authority's nuclear stations and the first of the CEGB nuclear power stations.

The equipment comprises two power manipulators, each with a lifting capacity of 750 lb; a 1½ ton hoist capable of lifting from 30 ft to 2 ft 6 in below rail level, both straight and at an oblique angle; three cable take-up units; and the associated rails, deflection pulleys, flexible cables and brackets.

Both the manipulators and the hoist employ a common set of rails and the design is such as to permit simultaneous working in the same cave or separately in different caves. Control of operation will be from separate movable consoles.

A hand will be fitted to each manipulator opening a maximum distance of 5 in, but a remotely interchangeable hook will also be supplied. The installation will be arranged so as to permit the manipulators to traverse the full length and breadth of the decanning and decontamination caves.

Another Firm Buys Executive Aircraft

Another step in the general trend towards increased mobility for executives was taken recently when DAVY-ASHMORE Limited purchased a Beech-Craft Queen Air aeroplane from SHORT BROTHERS & HARLAND Limited, the distributors for the British Isles.

The expansion and diversification of the Group's activities has necessitated a substantial increase in the amount of travelling undertaken by senior officials, especially to branches and customers overseas. In addition to the benefits afforded by more flexible itineraries and the arrangement of trips at shorter notice, a considerable saving will be effected in valuable travelling time. The Beechcraft Queen Air is an all-metal low-wing monoplane with two supercharged fuel injection engines giving it a maximum speed of 239 mph in level flight. It has a range of 1,000 miles and has room for six people and their baggage in addition to work tables and other aerial office facilities. It is fully instrumented for all-weather flying and its "weather avoidance" radar equipment assists the pilot to choose the smoothest possible route.

More Trade with the USSR

A substantial order from the USSR has been secured by ROBERT KEELIE & Son Limited of Dundee, a subsidiary of the VOKES GROUP. The contract is valued at £400,000 and the thoroughness of Russian business methods is exemplified in the negotiations which took ten months to complete. The order is from TECHNOPROMIMPORT and covers the supply of equipment for the storage of potatoes, and the manufacture and packaging of potato crisps, chips and potato cakes.

British Firm To Build German 3-Wheeler

TROJAN Limited, whose premises in Croydon now constitute the production division of LAMBRETTA CONCESSIONAIRES Limited, have obtained the manufacturing and sales rights of the Heinkel three-wheeler hitherto imported from Germany.

Production of the vehicle, which has room for two adults and two children and is said to cruise at 50 mph with fuel consumption rate of 90 mpg, is scheduled to commence in September. An output of 100 units per week is envisaged, possibly to be increased later if sales exceed the supply. The existing distribution arrangements established by Heinkel will be maintained and extended, but the vehicle will be renamed the Trojan Car to distinguish it from the Heinkel scooter which is not included in the agreement. Service, spares and general after-sales administration will be directed by Trojan who, by this step, re-enter the private car market after a break of over 20 years, post-war production having been limited to commercial vehicles.

Considerable interest is claimed to have been shown in the Trojan car on the home market, in addition to which sizeable order-inquiries have been received from South America, Austria, Denmark, Jamaica and Switzerland.

Steady Increase in Car Accessories Exports

Following the decision of the US FORD Company to purchase steering gear from BURMAN AND SONS and leaf springs from TOLEDO WOODHEAD SPRINGS, it is becoming increasingly apparent that there is a growing tendency among foreign motor manufacturers to import accessory components made by British specialist producers. The latest sign of this trend comes with the announcement that CONCENTRIC have completed arrangements to supply brake parts to the FAWICK CORPORATION of America who hold a licence agreement with GIRLING Limited, the brake manufacturers of Tyseley, Birmingham. The brake components Concentric will supply, are parts for an assembly designed by Fawick/Girling which will be fitted to US built commercial vehicles. Girling themselves are also finding that much interest is being shown abroad in their disc braking system and one of the latest of the big concerns to discard the drum on some of its models in favour of Girling discs is Fiat of Italy.

HARDY SPICER Limited also have a contract with an Italian firm, this being LANCIA, to whom they supply universal joints for the 1½ litre Flavia saloon which has front-wheel drive. The order is worth £300,000 a year at present but will probably increase as production goes up when this, the first Italian FWD car, becomes more firmly established. The joints are of the constant velocity type similar to those in use on the Austin Seven and Morris Mini-Minor; 300,000 have so far been built and the manufacturers claim long life and exceptional reliability.

Increase in Machine Tool Deliveries

Figures released by the MACHINE TOOL TRADES ASSOCIATION show a substantial increase in the number of machine tools delivered both at home and overseas for the month of May compared with the corresponding period last year, as illustrated in the accompanying table showing the value in £'000. The upward trend is maintained in the number of orders outstanding at the end of the month but there was a decline in new orders received for the home market and this may well be reflected in home deliveries during the next period. New orders from abroad were considerably increased, probably due to the fact that the delivery position is now more competitive.

	Home £'000		Export £'000	
	May, 1961	May, 1960	May, 1961	May, 1960
Deliveries during month ..	7,759	5,380	1,911	1,726
Order book at month end ..	85,453	64,867	27,063	19,955
Net new orders	8,598	10,865	3,527	2,093

Fabric Manufacturers in Merger

As from 26 August, 1961, the Narrow Fabrics Department of SMALL AND PARKES Limited, the manufacturers of "DON" brake and clutch linings, will be merged with WILLIAM KENYON AND PLATTS (Narrow Fabrics) Limited to form a new company to operate under the name of William Kenyon Platt and Parkes Limited.

The object of the merger is to increase output and improve production techniques, and the collective resources of the two concerns will be housed at the William Kenyon works in Dukinfield, Cheshire. Plant and machinery is at present being moved from the Hendham Vale, Manchester, works of Small and Parkes and a number of personnel have agreed to transfer. The merger will make the new concern one of the largest manufacturers of spindle tapes and narrow fabrics in the United Kingdom, and the product range will also include webbings for aircraft and car seat safety belts.

German Airline Buys More Viscounts

Lufthansa German Airlines have just taken delivery of their tenth Vickers Viscount 814 at Hamburg Airport. One more of these short to medium range prop-jets will be delivered shortly to complete the Lufthansa Viscount fleet.

Jaguar Car Production Increased

In spite of last winter's recession in the motor industry, JAGUAR CARS LIMITED, the only major concern to maintain full production throughout the year, announce that sales for the financial year 1960-61 show an increase of 15 per cent over the preceding year. During the final week of this period, a production record was established which represented an increase of 16½ per cent over the previous record set up in March this year. Demand has been maintained for all models in the range and the latest edition, the very high performance E-type is soon to be produced at a rate of 150 per week. The first 54 for the home market have just become available.

Jaguar, who recently took over the interests of the Daimler Company and thus now incorporate a commercial vehicle division, operating under the name of TRANSPORT VEHICLES (DAIMLER) Limited, also announce that an order has been received for 40 CVG 6 double-deck bus chassis from the Kowloon Motor Bus Company of Hong Kong. The value of the new contract is in excess of £112,000, and when added to the 30 Daimler chassis already on order will bring the number of Daimler buses run by the Kowloon Motor Bus Company to 395.

Ruston-Bucyrus 22-RB Excavator

A popular piece of equipment, mainly the result of pursuing the convertibility characteristic for the front end equipment.

THE Ruston-Bucyrus 22-RB excavator is the mechanized navvy; the present-day counterpart of the workman formerly employed on contracts involving the removal of large quantities of earth. It reflects the fundamental need for a fully versatile excavator that, by means of changing the front-end attachments, can be used with equal success in several forms; for example, as a crane or as a dragline.

The continued success of Ruston-Bucyrus Limited in the design and production of excavators of all sizes is based on the ability of their machines to put on a good show with almost any kind of front-end equipment. In the first instance, designing a machine to perform effectively the strenuous task of excavation meant building into it certain characteristics—some of which were capable of further exploitation by adapting the excavator for different kinds of operation. The success of any truly versatile machine—and this applies not only to excavators—lies in recognizing such characteristics for what they are worth and using them.

But it is not yet possible in this world to get something for nothing. Characteristics built into a machine enabling it to perform one particular operation, are only likely to give the optimum benefit for that one duty. To make the machine ideal for a different operation, modifications embodying new characteristics would have to be applied, some of which would certainly conflict with those for the original operation. So we would finish up with a different kind of machine, no longer ideal for its original job. The answer lies, of course, in compromise.

The degree of compromise on which any machine will ultimately depend for its success will determine the amount of sacrifice that can be tolerated in the efficiency of performance of the original operation. To offset the possible detrimental effect of increasing versatility, there is the factor of continuous technological advancement to increase the machine's effectiveness.

EXCAVATOR SPECIALISTS

The main point to bear in mind about Ruston-Bucyrus is that they are specialist excavator manufacturers backed by an efficient organization, who are not prepared to sacrifice specifications in order to cheapen their products. Their range extends from the ⅜ cu. yd 10-RB up to the impressive walking draglines and mine and quarry shovels. The 22-RB excavator is an outstandingly popular machine from a large and well respected range.

It is many years now since it first became evident that excavators should be made more adaptable to enable them to perform a greater variety of jobs on a site. The two contributory factors were, firstly, the growing need to conserve manpower and, secondly, the economic advantages of keeping the machines more fully employed. The principle of making excavators more versatile by offering interchangeable sets of front end equipment was pursued by the majority of manufacturers, including Ruston-Bucyrus, though certain firms preferred to concentrate on extended use of the same basic parts. When they introduced the 22-RB ¾ cu. yd machine in 1950, Ruston-Bucyrus carried the principle of convertibility a stage further, reaching the point of compromise beyond which some sacrifice of the machine's basic excavator function would have been inevitable.

Today earth-moving equipment on the market falls into two broad classes. One is the excavator type of machine in which the machinery base remains in one spot and the bucket moves in a path governed by a long arm or boom. The other is the machine which travels with the earth it is removing, for example, the bulldozer, scraper or front end loader.

The earliest jobs demanding the removal of earth in large quantities were in the construction of canals and railways. Prior to the 1870's the job was performed by hand, the workman being known after the navigation canals as a "navigator" or navvy. When steam power was first applied to perform the excavation mechanically, the machine was called the "steam navvy."

A feature of railway construction is that the digging is generally performed in one direction, so the steam navvy had its machinery mounted directly on a rail chassis, with provision for an angle of slew of the boom just sufficient to load trucks placed alongside. Full circle slewing, in which the boom was fixed to the machinery deck and the whole mounted on a pivot, was provided on cranes almost from the start, but was not applied to excavators until about the turn of the century. By this time railway construction was declining and their usefulness for other kinds of material gathering, such as removing quarry overburden, was becoming recognized.

The first 360° machine excavators were developed by Whittaker Brothers of Leeds, and consisted essentially of a crane with shovel attachments. The next important step was the introduction of crawler tracks in place of rail wheels to provide greater mobility. Then, after 1912, steam drive started to give way to electric motor or internal combustion engine drive, though it was some time before the new forms of power approached steam for reliability.

The roots of Ruston-Bucyrus can be traced back to 1857 when the firm of Ruston and Proctor started at Lincoln. At first steam engines and agricultural machinery were their mainstays, and in 1874 they produced the first steam navvies. Later they acquired Whittaker Bros and after a few years the name changed to Ruston and Hornsby. By 1922 a complete range of diesel engined excavators was offered, mainly crawler mounted. An outstandingly popular

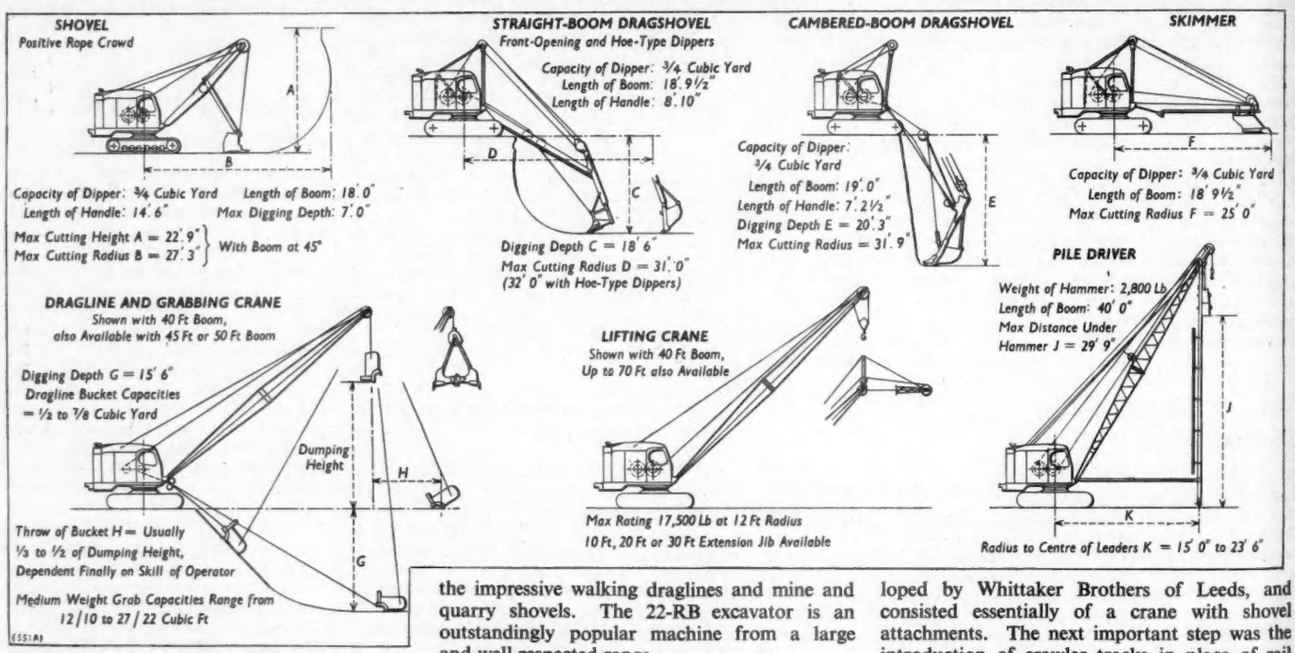

SHOVEL
Positive Rope Crowd
A
B
Capacity of Dipper: ¾ Cubic Yard
Length of Handle: 14' 6"
Length of Boom: 18' 0"
Max Digging Depth: 7' 0"
Max Cutting Height A = 22' 9"
Max Cutting Radius B = 27' 3"
With Boom at 45°
STRAIGHT-BOOM DRAGSHOVEL
Front-Opening and Hoe-Type Dippers
Capacity of Dipper: ¾ Cubic Yard
Length of Boom: 18' 9½"
Length of Handle: 8' 10"
D
C
Digging Depth C = 18' 6"
Max Cutting Radius D = 31' 0"
(32' 0" with Hoe-Type Dippers)
CAMBERED-BOOM DRAGSHOVEL
Capacity of Dipper: ¾ Cubic Yard
Length of Boom: 19' 0"
Length of Handle: 7' 2½"
Digging Depth E = 20' 3"
Max Cutting Radius = 31' 9"
E
SKIMMER
F
Capacity of Dipper: ¾ Cubic Yard
Length of Boom: 18' 9½"
Max Cutting Radius F = 25' 0"
DRAGLINE AND GRABBING CRANE
Shown with 40 Ft Boom,
also Available with 45 Ft or 50 Ft Boom
Digging Depth G = 15' 6"
Dragline Bucket Capacities
= ½ to ⅞ Cubic Yard
Dumping Height
H
G
Throw of Bucket H = Usually
⅓ to ½ of Dumping Height,
Dependent Finally on Skill of Operator
Medium Weight Grab Capacities Range from
12/10 to 27/22 Cubic Ft
(5511A)
LIFTING CRANE
Shown with 40 Ft Boom,
Up to 70 Ft also Available
Max Rating 17,500 Lb at 12 Ft Radius
10 Ft, 20 Ft or 30 Ft Extension Jib Available
PILE DRIVER
Weight of Hammer: 2,800 Lb
Length of Boom: 40' 0"
Max Distance Under
Hammer J = 29' 9"
J
K
Radius to Centre of Leaders K = 15' 0" to 23' 6"

Fig. 1 (above) The seven front-end equipment variations of the 22-RB.

Fig. 2 (below) Early Ruston steam navvy.

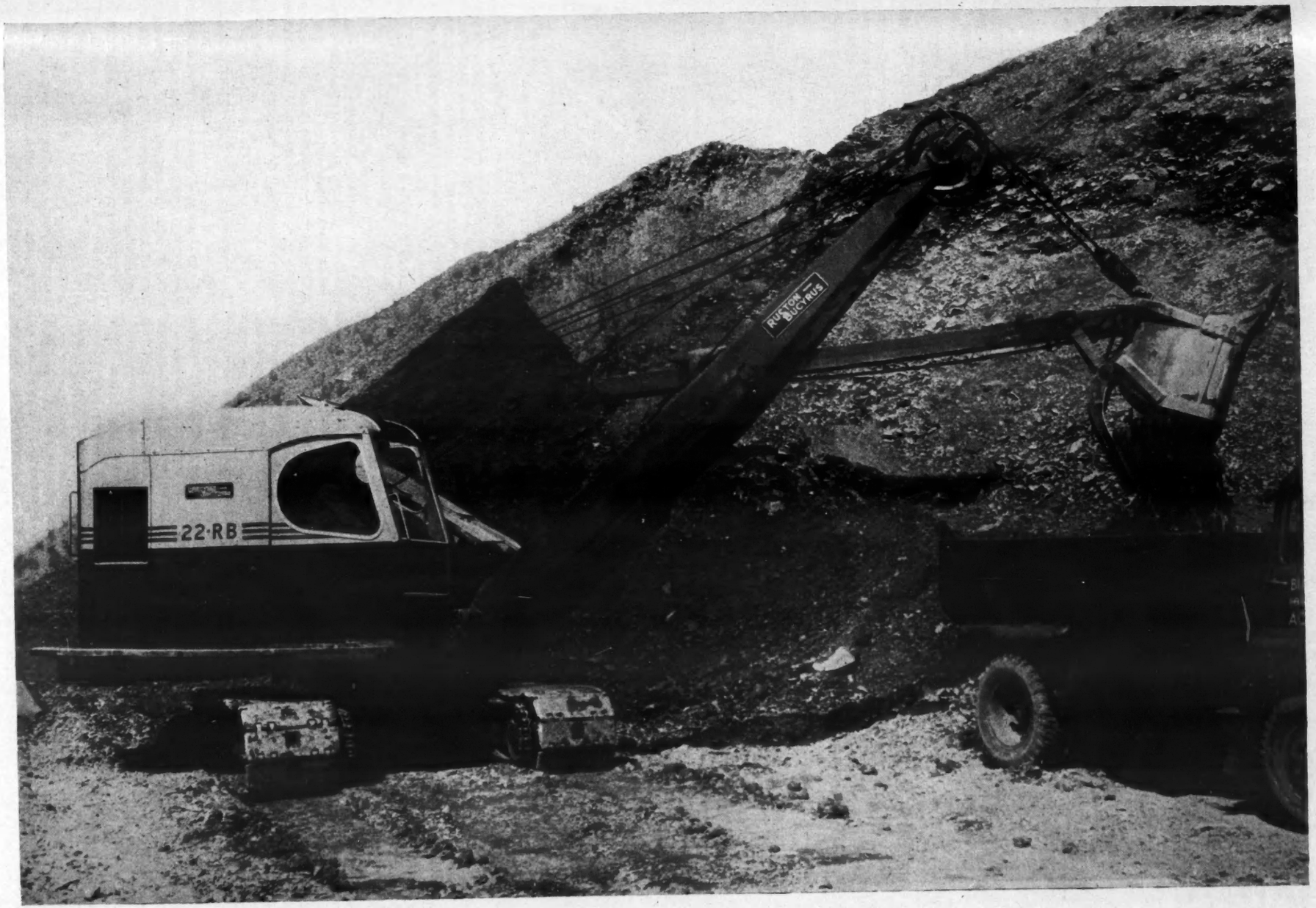


Fig. 3 The machine that reflects the accumulated knowledge of nearly 90 years.

machine of the period between the wars was the Ruston No. 4 of 1926, with a ½ cu. yd capacity.

The association with Bucyrus Erie of Wisconsin, USA, took place in 1930, that company having had nearly fifty years of experience, making firstly railroad steam navvies and later excavators. The English company sorely needed new equipment and manufacturing techniques, and, coincidentally, both firms were seeking to establish a connection on the opposite side of the Atlantic. Each subscribed half the capital to form a new company with a joint board of directors, Ruston-Bucyrus Limited. Ruston's share consisted of the Lincoln excavator plant.

Lincoln is a cathedral city with a population of 73,000 and many ancient historical associations It provides a home for several other well established engineering firms including Ruston and Hornsby, an associate; Clayton and Shuttleworth, and Robey and Company. The eastern half of England has always tended to be associated with cranes and excavators.

THE SHOVEL

The shovel form of excavator may be regarded as the basic version of the 22-RB as illustrated in Fig. 3. The shovel is defined as a dipper or bucket excavator with an upward cutting action, being held against the work face by means of a rigid arm attached midway along the boom. This arm is provided with a controllable thrust by means of a motion known as "crowding."

The skimmer, in which the bucket is guided and digs by travelling forward along the boom, used to be another popular type of equipment, but its use is steadily declining. In recent years the dragshovel has come into greater prominence for trenching and open-cut work. The dragline originated in America and is a particularly suitable form for the bigger machines dealing with a large quantity of earth over a wide area.

How does the 22-RB fit into the general pattern of the specialist excavator maker's products? When the first prototypes were built in 1950, they corresponded closely in size with three earlier machines in the range, the 17, 19 and 20-RB, having capacities of ½, ⅝ and ¾ cu. yd respectively. Today only the 19-RB remains on the market, to satisfy a particular need for a ⅝ cu. yd machine. The improvements built into the 22-RB may be summarized:

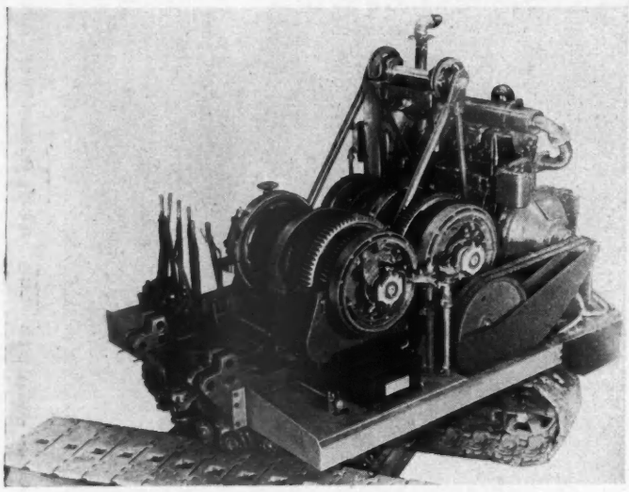
(1) Larger crawler tracks and base to improve stability.
(2) Increased engine power and machinery strengths.
(3) Bigger range of crane and dragline ratings.

Later came the introduction of power controlled load lowering for crane service. The crane and dragline ratings are mainly dependent upon the track size and in this instance enabled an increase in boom length from 40 to 70 ft. But efficiency and manoeuvrability using shovel attachments dictate a limit to the size of track, and it is these basic considerations which have so successfully been compromised in the 22-RB.

There is, however, no compromise in the details. No attempt has been made at slavish standardization of parts within the range, and only certain small components are common to more than one size of machine. The maximum load that each stressed part is likely to encounter is known and it is designed accordingly. Ruston-Bucyrus do not believe in giving the customer excess weight. Such a policy produces a design that is just right for the job, and at a competitive price, thanks to advanced production techniques using comprehensive jigs and fixtures.

Steel castings are used extensively in construction, including both the truck frame and the revolving frame. An oversize crawler mounting is offered for dragline and crane work on exceptional ground conditions.

Fig. 4 (below) Engine and machinery layout.



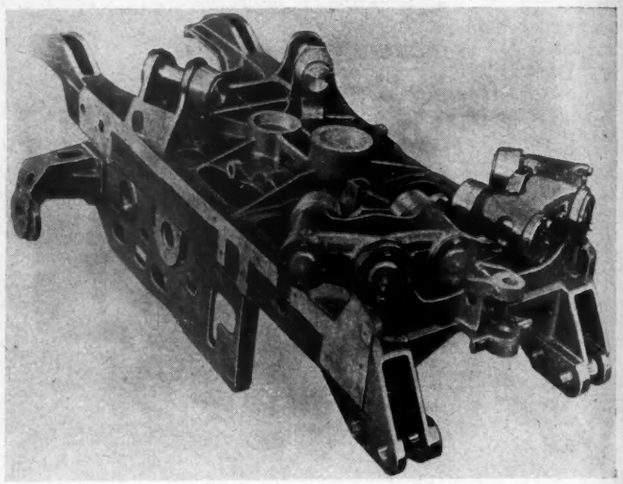


Fig. 5 (above) A study in cast steel—the revolving frame with swing rollers attached.

The revolving frame runs on swing rollers conical in shape to avoid slip on the circular track. The rollers run in a double flanged path cast integral with the truck frame and taking advantage of the maximum lever arm to reduce stresses. Long life is an essential factor of the swing rollers and track, but if necessary the rollers can be replaced without jacking the machine up off its truck.

A 40 hp electric motor can be substituted for the 66 hp Ruston and Hornsby water or air cooled diesel. Transmission losses are minimized by keeping down the number of moving parts, by the extensive use of ball and roller bearings and by using enclosed flood lubrication wherever possible. The various motions are controlled through a master clutch and a system of individual clutches, all designed to give the good "feel" so essential to responsive control, and to produce uniform results whether hot or cold. Those clutches on which slipping demands are greatest are placed in the best ventilated positions.

The variety of jobs for which the 22-RB is designed is strictly controlled by Ruston-Bucyrus. They find that many customers try to make the machine do more, though the 22-RB is one of the most versatile machines on the market.

Beyond the primary functions, the following technical considerations have played a part:—

(1) Long-lasting finish without rusting.
(2) Operator comfort and good field of vision.
(3) Easy and responsive control.
(4) Simplicity of maintenance.
(5) Adequate safety considerations.
(6) Economical manufacture.

All these qualities have been blended by the stylist into a machine of exceptionally attractive appearance, the company having realized the importance of aesthetic effect in the surroundings in which their machines will be working. Every reader will be familiar with the standard Ruston-Bucyrus livery of dark green boom and two-tone yellow and maroon cab, but the preservative quality of the paintwork is less obvious. The metal finishing and painting process employed at Lincoln includes shot blasting, acid process rust prevention and hot paint spraying. All nuts and bolts on the exterior of the stove-enamelled cab panels are cadmium plated.

Ruston-Bucyrus maintain close contact with the customer both before and after sale through sales engineers who are all technically qualified and can discuss the customer's excavation problems with him in his own language. The factory site covers 43 acres and is the largest in Europe for the exclusive manufacture of excavators.

They also have a highly efficient service and spare parts organization capable of dealing with machines up to forty years old. They claim to offer the maximum value for money and so justify the slightly higher price sometimes asked for an RB machine.

This policy is successful Their total turnover is roughly equal to the total UK excavator requirement. Half the machines go to the home market and the other half abroad where the biggest markets lie in Europe, the Commonwealth countries, and Africa. 22-RB production amounts to roughly 400 per year, 55 per cent of which are sold overseas. Of those sold in this country, over half go to public works contractors and the rest mainly to quarries, iron and steel, sand, and gravel, clay and brick concerns, public bodies and plant hire firms.

What of the future? The transit type of machine on a Foden chassis came in in 1957 and as the need for mobility becomes even greater its popularity will no doubt gradually expand. More important, increased use of hydraulics in auxiliary excavator controls lies just around the corner.

V-Bomber Equipment Adapted for Skybolt

Details have been released of the development programme required to adapt the Skybolt air-to-surface missile for use on Britain's V-bombers.

It was in April, 1960, that the Minister of Defence announced that the United Kingdom was negotiating for the purchase of the American Skybolt missile in place of the cancelled Blue Streak. Information has since been released that arrangements are well advanced for installing Skybolt on the Avro Vulcan B2 bomber and that British firms will play a major part in the aircraft modification programme.

A. V. Roe Limited, manufacturers of the Vulcan, have been given the responsibility for modifying the airframe to accommodate the missile. Associated Electrical Industries Limited have been given the task of specifying the modifications necessary in the existing navigation system to suit Skybolt, and of the development and manufacture of the fully transistorized conversion equipment for linking the existing system with that of the new missile. This is being carried out by AEI's Electronic Apparatus Division which has extensive experience in the development of the present V-bomber navigation and bombing computer network.

The missile guidance system works in digital language and it is the function of the new AEI conversion unit to transform navigation information from its original analogue form into the required digital form without loss of accuracy.

Industrial Application of Cloud Chamber

A highly sensitive device that can be used to measure air pollution has been developed by the United States General Electric Company. It is said to be able to detect one particle among 10^{15}.

The new instrument is used to detect "condensation nuclei," the smallest of all airborne particles. The nuclei, which can only be seen with the aid of an electron microscope, are extremely numerous and a major factor in the formation of smog. Engineers at General Electric believe that the condensation nuclei detector will help in the designing of air filters of greatly increased effectiveness.

Once it becomes commercially available, this ultra-sensitive instrument should be of value in several other industrial applications. For instance, it could be used with auxiliary equipment to detect radioactive particles and, in most cases, to trace them to their source. It could also have applications as a fire monitor.

The detector works by causing droplets to form around each of the nuclei, which are then large enough to scatter a light beam. The diffused light is measured electronically and the reading indicates the concentration of the nuclei with a sensitivity exceeding one part per thousand million. This accuracy is achieved by continuous operation in which five to eight cloud masses per second are formed and measured inside a cloud chamber. Previous laboratory detectors took measurements spaced more than a minute apart, and yielded results from which average readings were taken.

This continuous operation may make it suitable for automatic monitoring of air in remote locations, and for detecting and identifying gases. The latter cannot be detected directly by the device, but an indirect measurement is possible if the gas molecules are combined with substances to give them a solid or liquid form. This is accomplished through the use of converters specially designed for the requirements of each basic group of gases. Only inert gases—such as helium, argon, and krypton—do not lend themselves to this treatment.

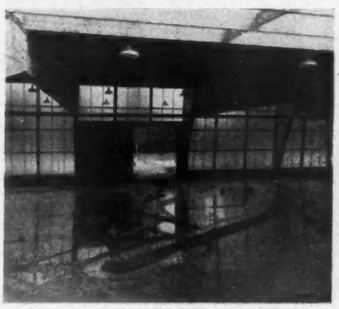
Among the projected industrial applications is the difficult task of adjusting carbon brushes on electric motors. Sparking caused by faulty adjustment produces nuclei which immediately indicate the trouble spots. Similarly, the safe temperature range for electrical insulation could be determined quickly and accurately, without destroying the material to be tested, by heating the insulation to the point where it begins to give off the invisible nuclei. This occurs well before the insulation begins to break down.

Fireproof Cables in Timber-Built Laboratory

Some 2,500 yards of mineral insulated cables, manufactured by British Insulated Callender's Cables Limited, have recently been installed in the new wave basin enclosure at the Hydraulics Research Station, Wallingford, Berkshire.

The 242 ft long enclosure was specially designed to house two wave basins. Constructed of laminated softwood frames clad with cedar to a Swedish system which provides good structural strength without the need for columns to support the roof (it is essential for the functions of the basins that they are left unobstructed) the enclosure incorporates two large wooden spans of 114 ft and 96 ft in length. The two ends of the building are completely glazed.

The function of the wave basins is to facilitate study, on a model scale, of problems such as those concerning harbour design, ship behaviour and erosion of beaches. Designs for harbours and similar installations for many parts of the world have been tested by the Hydraulics Research Station. The main item of ancillary



The Hydraulic Research Laboratory's new wave basin enclosure is made entirely of wood. Mineral insulated electrical cables are used throughout the building.

equipment used to achieve full-scale effects in the wave basins is a wave-making machine.

BICC mineral insulated cables are used throughout the enclosure, twin-core being employed to wire more than 100 lamps of 300 watt rating and three-core wire being used for twenty-four 15 amp watertight sockets, of which there are 12 in each basin. Being fireproof, these cables are particularly suitable for installation in a building of wooden construction.

Architect of the enclosure was Mr. O. P. Carver, Senior Architect at the Ministry of Works. The electrical contractor was R. McEwan and Company (Woking) Limited.

Smoke Removal from Diesel Exhaust

The recently issued annual report of the Warren Springs Laboratory states that several methods have been examined for removing the smoke from the exhaust fumes of diesel engines.

Catalytic combustion, filtration and scrubbing have all been tried experimentally and other methods have been considered theoretically. While smoke can be removed from the exhaust under laboratory conditions, no cheap, reliable method could be devised for practical application to road transport. A 10 ton diesel lorry (see illustration) has been used to test two devices that were claimed to remove smoke from diesel exhaust; both, however, proved to be unsuccessful. A third device, based on an electrostatic precipitator, is now under examination.

In view of the ease with which, by proper operation and maintenance, the emission of smoke can be prevented, and the difficulty of removing it once the exhaust has been formed, it has been decided to stop further experimental work on methods of removal. Instead, investigations will be made to see whether it is possible to develop a device to measure the density of the smoke clouds emitted from vehicles.

Techniques are being tried to establish a device that will measure the smoke output from diesel-engine vehicles.

Such an apparatus could be used as an aid to setting and, if necessary, enforcing a satisfactory standard of practice. Preliminary work has shown that it might in some circumstances be possible to measure the obscuration produced by the exhaust smoke of a particular vehicle by means of an instrument mounted on a bollard in the middle of the road, or on an overtaking vehicle.

Automation in Electrical Power Stations

Electric power generating plant of the near future may rely completely on automatic control, with significant savings to utilities.

In a paper presented at a recent meeting of the American Society of Mechanical Engineers, Mr. J. K. Dillard, manager of electric utility engineering for the Westinghouse Electric Corporation, and Mr. J. L. Everett, director of research for the Philadelphia Electric Company, reached the following conclusion on steam power plant automation.

"While heat rate and reliability improvement are certainly factors in justifying automation, the real economic justification lies in two places. One is the elimination of manual control. The other is in the reduction of the cost of generation apparatus when it is designed for strictly automatic operation. This implies that the power plant of the future will have provision for automatic control and rely on it completely. The resulting savings should be significant."

The authors offered several economic incentives for automatic control, noting that the most important are increased reliability, improved operating efficiency, and more productive use of manpower. It was pointed out, however, that behind each economic incentive has been the growing complexity of steam power apparatus and its operation.

"This complexity has made it increasingly important to replace the judgment of the human operator with automatic equipment. Because human operators cannot react fast enough to hold transients within design limits, analogue devices increase reliability. These devices also improve operating efficiency by holding plant variables near optimum values," they reported.

The writers said that both sequential control, in which human operators now start and stop plants and deal with emergencies, and dynamic control which involves such variables as temperature and pressure, can be automated by a central, high-speed, solid-state digital computer.

Six computer controlled power stations are now under contract in the United States electric utility industry.

Special Methods for Scottish Roads

Road engineers in Scotland face some special problems—largely due to the climate, subsoil and the emphasis on low cost construction in the more remote areas—which can only be solved by investigations on the spot.

By J. R. Lake, B.Sc., A.M.I.C.E.

THE special problems of Scottish road engineering set a limit on the uses that can be made of the extensive work on materials and construction and on traffic and safety undertaken by the Road Research Laboratory, Harmondsworth, and so, in 1949, the Department of Scientific and Industrial Research set up a branch of the Road Research Laboratory at Thorntonhall, Glasgow.

The Scottish Branch carries out research on problems particular to Scotland, encourages the application of the results of this work and makes known to all in Scotland who are concerned with roads and traffic the research undertaken by the parent laboratory.

Peat Areas

Peat occurs in many regions in Scotland. This soft, water-filled organic material compresses when a road is constructed over it and this often results in a wavy and uneven road surface of poor riding quality. When trunk roads are constructed through areas of peat the normal practice nowadays is to excavate the soft soil and replace it with more stable mineral soil. This, however, can be expensive and sometimes difficult when peat of depth greater than 10-15 ft is encountered. As a first step in a programme of research to study the problem, a review was prepared of the methods used in various parts of the world for constructing roads over peat. This showed how diverse were the techniques employed, and as no large claims of success were made for any particular method it appeared that the problem remained largely unsolved. During the past five or six years, therefore, the Scottish Branch has been engaged in laboratory, small-scale and full-scale experiments to study the behaviour of peat during compression.

When peat is compressed some of the water in it is expelled and the organic fibres are pressed closer together so reducing the total volume of the peat. Normally some time must elapse before this process is complete, and it is this slow change in volume which causes roads built on peat to settle over a long period of time, with consequent adverse effect on the shape of the road surface. It follows, therefore, that any successful method of constructing roads over peat must either prevent this volume change or encourage it to be completed as quickly as possible, preferably before the final road surfacing is laid.

In addition to being highly compressible, peat has a very low shear strength and if loaded quickly, it becomes overstressed and is displaced from under the road being built on it. This can present particular problems nowadays when modern earth moving plant can construct road embankments very rapidly.

One method used extensively in USA for increasing the rate of drainage of water from clay and organic soils is to install a system of vertical sand drains in the soft soil. These columns of sand, suitably spaced and of large enough diameter, are intended to be convenient drainage channels through which water can escape quickly when the soft soil is compressed by a road embankment. Their use is based on the theory of consolidation of clay which states that the rate of compression of clay when loaded depends on the square of the distance in the soft water-filled soil through which the soil water has to pass to escape. Vertical sand drains were employed during the construction of part of the Glasgow-Stirling trunk road A.80 in Dunbartonshire where it crosses a deep pocket of peat (Fig. 1).

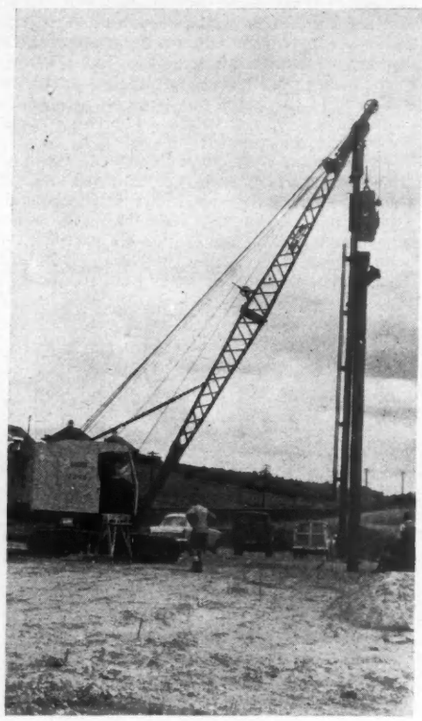


Fig. 1 Driving vertical sand drains at Condorrat, Dunbartonshire.

At the suggestion of the Research Laboratory, sand drains were omitted from the peat under a short length of road embankment to enable a comparison to be made of the behaviour of the embankment on peat with and without sand drains. Settlement observations have shown that, contrary to the theory, the sand drains did not increase the rate of compression of the peat containing them. Similar results were obtained with small-scale loading tests on peat bogs in Ayrshire and Renfrewshire, and laboratory tests showed that the depth of sample of peat did not affect the percentage rate of compression of samples confined laterally. Although the results of these experiments were negative the information is of considerable importance as it leads to a better understanding of the physical properties of peat. Further loading experiments are planned.

Local Materials

The Laboratory has also been studying the materials available locally for road construction in Scotland. In the Lowlands where oil shale and coal are extensively mined, there are large deposits of burnt colliery and oil shales, and samples from various " bings " have been tested by the Branch. These were considered suitable for road construction and a full-scale experiment made in 1953 on a housing estate in the Burgh of Kirkcaldy successfully demonstrated the usefulness of shales in road base construction. From being a waste material a few years ago with no easy outlet for disposal, these materials are now used extensively in the Lowlands of Scotland (Fig. 2) and indeed spent oil shale is being used to form the embankment to carry part of the approach roads to the Forth Road Bridge.

Although Scotland abounds in natural rock there are relatively few crushed stone quarries in the north and west of the country, and the Laboratory has been investigating the possible use of glacial gravels for road construction in these areas and considering the material as an alternative road aggregate in other regions where crushed stone is available. Large deposits consisting of mixtures of boulders, gravels, sand, silts with a trace of clay exist in most parts of Scotland with the possible exception of the south east. An experiment in Wester Ross in 1956 showed that glacial gravels mixed with small proportions of cement produced satisfactory road bases (Fig. 3). The experiment was laid between Gairloch and Melvaig on the class II road, which had a gravel surface at that time. As part of the county's programme of work, the road was to be strengthened and surfaced for the first time with bituminous materials.

A series of experimental road bases, 6 in thick, were constructed by mixing-in-place proportions of cement ranging from 2 to 7 per cent with glacial gravels obtained from nearby borrow pits. The gravel was screened to remove stones larger than 2 in and was laid on the road to the required thickness before cement from bags was spread over it. Sufficient water was present in the gravel for mixing purposes and mixing was done with a rotary cultivator fitted to a small track laying vehicle. A 2½ ton roller was used to compact the gravel/cement mixtures. Surfacing with bituminous materials completed the work and the road has performed very satisfactorily for five years and compares favourably with an adjacent length constructed in a different way the same year as the experiment.

Many gravels, as dug from borrow pits or with a minimum of screening to remove large aggregate, may be used for this purpose on lightly trafficked Highland roads. On more heavily trafficked trunk roads, closer control of the aggregate grading is necessary and washing is often used to remove any deleterious organic matter. It is interesting to note that from being a low grade material for decades, glacial gravels are now being used with cement to form high quality bases for major trunk roads in Scotland.

Bituminous Surfacings

Scottish gravels are also useful as surfacing materials. Using the Scottish Branch's mobile screening and mixing plant, several experiments have been made in various parts of Northern Scotland to investigate the effect of aggregate grading and type and quantity of tar and bitumen on the lives and performances of bituminous road surfacings (Fig. 5). The largest experiment was made on trunk roads A.9 near Evanton, Ross and Cromarty, where more than 70 different experimental compositions were laid using ¾ in maxi-

Research Report

on work carried out in Scotland by the Road Research Laboratory.

Laboratory Headquarters
Harmondsworth, Middlesex

Scottish Branch
Thorntonhall, Glasgow

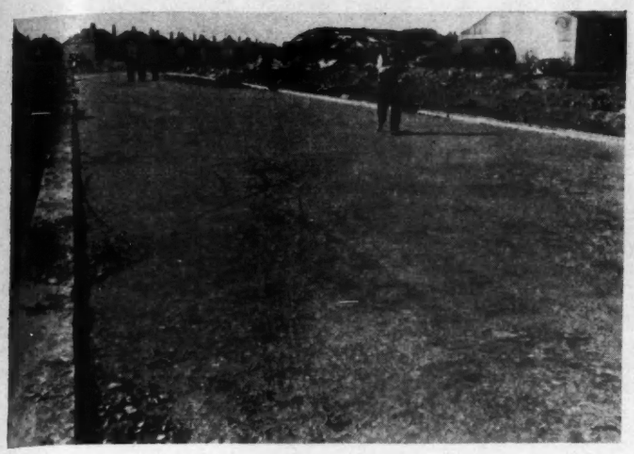


Fig. 2 Spent oil shale, a locally-available material, laid on a housing estate road in Grangemouth.

Fig. 3 Experimental road in Western Ross in which cement-bound glacial gravels were used as the base.

mum size aggregate with the range of gradings normally found in glacial gravels. Tar of 40° and 45° e.v.t. and residual bitumen of 200 and 300 penetration were used. Many of these surfacings laid 1½ in thick have proved to be dense, impervious to water and have behaved very satisfactorily. Research on this work is continuing and it is expected that one or two of the most promising compositions will be laid commercially by the Scottish Home Department in the next year or so. If results continue to be good these compositions may be included in future specifications.

Experiments have also been made using glacial gravels with the Swedish oiled gravel process. This process was developed in Sweden and is intended for use primarily in regions where severe frost may cause parts of a road to disintegrate resulting in the road having to be regraded and rolled. The heavy road oil coating the aggregate remains sufficiently fluid and "lively" to allow the mixed materials on the road to be ripped up and re-rolled if necessary. Normally bitumens and tars do not have this property and are usually relatively hard at ordinary temperatures. This material also has the advantage that it can be mixed and stockpiled for some time before being laid on the road. Some promising results have been obtained from experimental compositions laid in 1959.

Traffic Studies

Traffic studies have formed an important part of the activities of the Scottish Branch of the Laboratory. For example, regular surveys have been made in Glasgow and Edinburgh to study the factors affecting the flow of vehicles in the central areas. Mean journey speeds in Glasgow and Edinburgh are 8 and 13 miles per hour respectively with average traffic flows of 910 and 1,070 vehicles per hour. The lower speed in Glasgow is partly accounted for by the larger number of controlled intersections per mile and the narrower streets (39 ft in Glasgow compared with 51 ft in Edinburgh). The corresponding speed in Central London is 10 mph. Parking restrictions have been employed in Glasgow in an effort to improve traffic flow and studies were made of the effects of the "no waiting" regulations introduced in 1952 and 1958. These showed reductions of 69 per cent in the numbers of cars parked in the streets affected by the regulations, producing an increase of approximately 1 mph in mean running speed.

A feature of Highland scenery is the single track roads which usually have either trunk or class I classification. These roads are normally provided with passing places at intervals to allow vehicles moving in opposite directions to pass. An investigation was carried out in 1956 on a typical length of single track road to study the speed of vehicles in relation to the volume of traffic. This showed that a vehicle intending to travel at 35 mph could have its speed reduced to 28 mph if the total traffic flow on the road increased from 0 to 70 vehicles per hour. Work done by the main Laboratory in England on a two-lane road showed that a change in total flow of this order would not affect appreciably the average speed. The average flow on the single track road where the investigation was carried out was 70 vehicles per hour. On this basis it was estimated that it would take half an hour longer to make a 50 mile journey on the single track road than it would on a two-lane road.

In 1960 an investigation was started to study the effect of the new Forth Road Bridge on the traffic pattern in the region. During an origin and destination survey for one week in August of that year, 8,900 drivers of motor vehicles or 43 per cent of the total were questioned at three survey stations situated at Bridge of Allan, near the Kincardine Bridge and at South Queensferry to establish the traffic pattern in the region before the opening of the new bridge (Fig. 4). Studies of the journey times between various points north and south of the Forth will allow estimates to be made of the traffic likely to use the new bridge and the results will be compared with observations made after the bridge is opened to traffic. Research investigations of this type can lead to improved methods of estimating traffic likely to use new facilities.

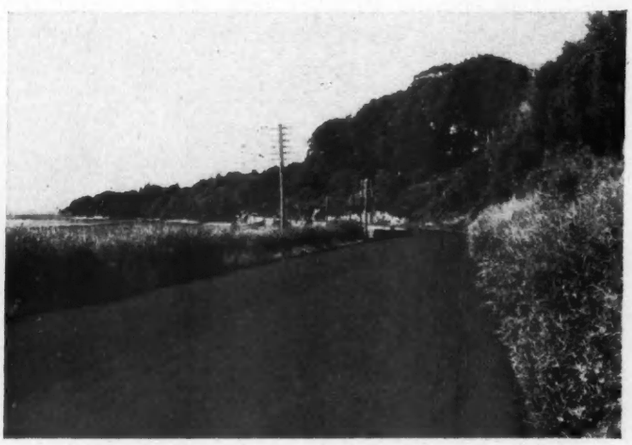
In addition to its varied research activities the Scottish Branch of the Laboratory endeavours to assist local authorities with their more immediate problems. For example, if a road surface begins to crack and deform before its considered useful life has expired, the Laboratory may carry out an investigation at the site to establish the cause of the premature failure and to suggest remedial measures. Again, the staff are prepared, wherever possible, to discuss alternative designs for new roads. Sometimes an engineer may be faced with a number of skidding accidents at a particular site. If so, the surfacing may be tested to establish whether the site is potentially slippery in wet weather. Since 1954, many of the bulk tankers used for spraying tar and bitumen on the roads during surface dressing operations in Scotland have been tested at Thorntonhall to check whether the machines conformed with the conditions for transverse distribution stated in the British Standard BS 1707. The majority of the sprayers tested required some adjustments but most were brought within the specification limits. This service undoubtedly led to an improvement of the quality of surface dressing in Scotland.

Acknowledgement

The work described in this article was carried out as part of the programme of the Road Research Board of the Department of Scientific and Industrial Research. The article is published by permission of the Director of Road Research.

Fig. 4 (Left) Questioning drivers at Queensferry during "origin and destination" survey.

Fig. 5 (Right) Experimental bituminous surfacings containing glacial gravel aggregate laid on trunk road A9, near Evanton, Ross and Cromarty



Building Report

THE work of the Building Research Station (Garston, Herts) is naturally of interest to most people, though comparatively few know much about it. The publication of the Station's latest report came close to the opening of new buildings for the materials laboratory by Sir Harry Melville, secretary of the Department of Scientific and Industrial Research. The programme there includes work on new materials and improved versions of well tried ones, under chosen conditions of temperature and humidity.

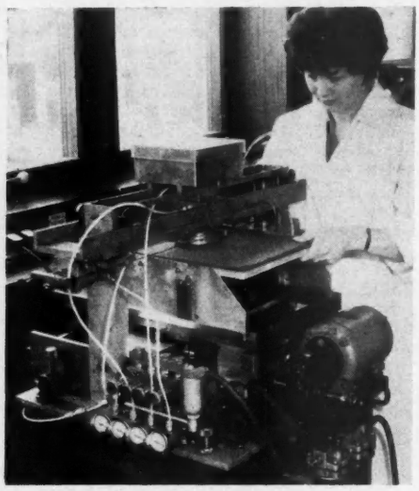
One of the newer studies being undertaken by the Station is that of noise. Extensive tests have been carried out on the alleged damage caused by low flying aircraft and by "sonic bangs." The study commenced some ten years ago and so far measurements of sound travel near the ground and of horizontal propagation have upset all previous theories. As yet there are no new ones to replace them. Vibrations in a house at the end of a runway have been measured when heavy jet aircraft were taking off, their height over the house being about 500 ft. In general no structural damage could be attributed to this cause, although some superficial plaster cracks occurred, but vibration became excessive when the passing height fell to 100 ft. The noise level is quoted as being "very high." In all investigated cases of damage caused by sonic bangs the amount has been "minor," a statement that does nothing to relieve the annoyance to the sufferers.

To counter the almost complete absence of information on noise levels in British cities, a grid has been set up in London with about 500 points spaced at intervals of 500 yards. The noise levels at each of these points will be sampled by means of magnetic tape recordings, once an hour, round the clock. The vans used to carry out this task are being manned and the necessary arrangements made by the London County Council; the results will be analysed at the Station. It is hoped from the results to improve the siting and planning of buildings, particularly those such as hospitals which are especially sensitive to noise.

Progress has continued with the development of the V brick shown in the lower illustration, type 8 being now in production. The V brick is twice the size of a normal brick yet only the same weight due to the perforations. It allows the equivalent of a two leaf cavity wall to be built in one operation thereby showing a considerable saving in time and labour. The bricks are now in limited commercial production and are proving entirely satisfactory in use. Production is a comparatively simple operation as the bricks are formed by cutting off lengths from a continuous extrusion.

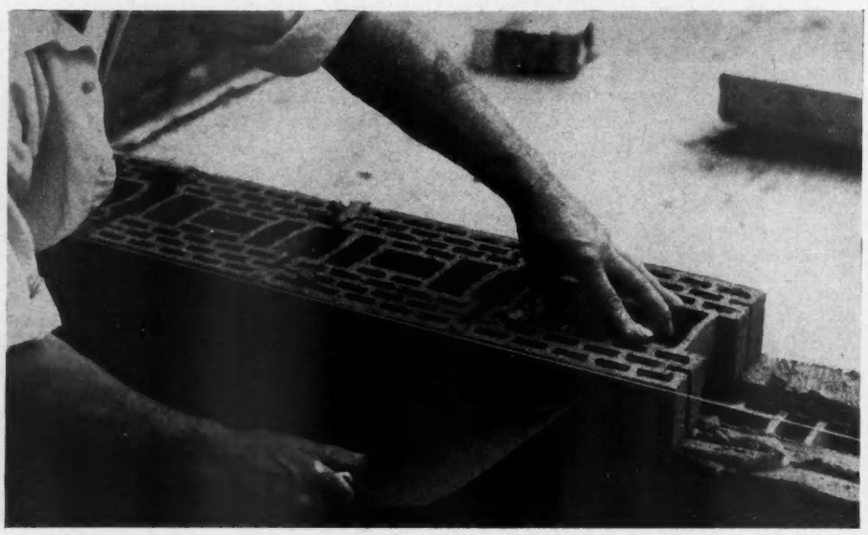
The amount of wear to which a floor can be subjected is enormous and the fashion of stilleto heels has discovered many weak spots. Some floor materials have the reputation of experience, but it is desirable to be able to assess new materials reasonably quickly. To this end, the Station undertook the measurement of the forces of walking using a force plate sensitive to the vertical, horizontal and torque forces involved. The area of the foot in contact with the floor and the period of contact were established by cinephotography and values were obtained for a wide range of people. The results gave the data for the testing machine shown in the upper illustration.

Correlation tests are now in progress to relate the results of the machine to results obtained in practice. Special flooring panels have been installed at the ticket offices of some Underground stations, the number of tickets sold giving a measure of the traffic over the surface. An interesting fact that has emerged is that stilleto heels have no effect on these panels. When the tests are complete it will be possible to estimate reasonably accurately the performance of new materials for which there is no practical experience by giving them an accelerated try-out in the machine.



(*Right*) *The probable performance of new floor materials can be assessed in this machine.*

(*Below*) *A two leaf cavity wall can be laid in one operation using the V bricks, which are only the same weight as a normal single one.*



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